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# What determines green purchase behavior?

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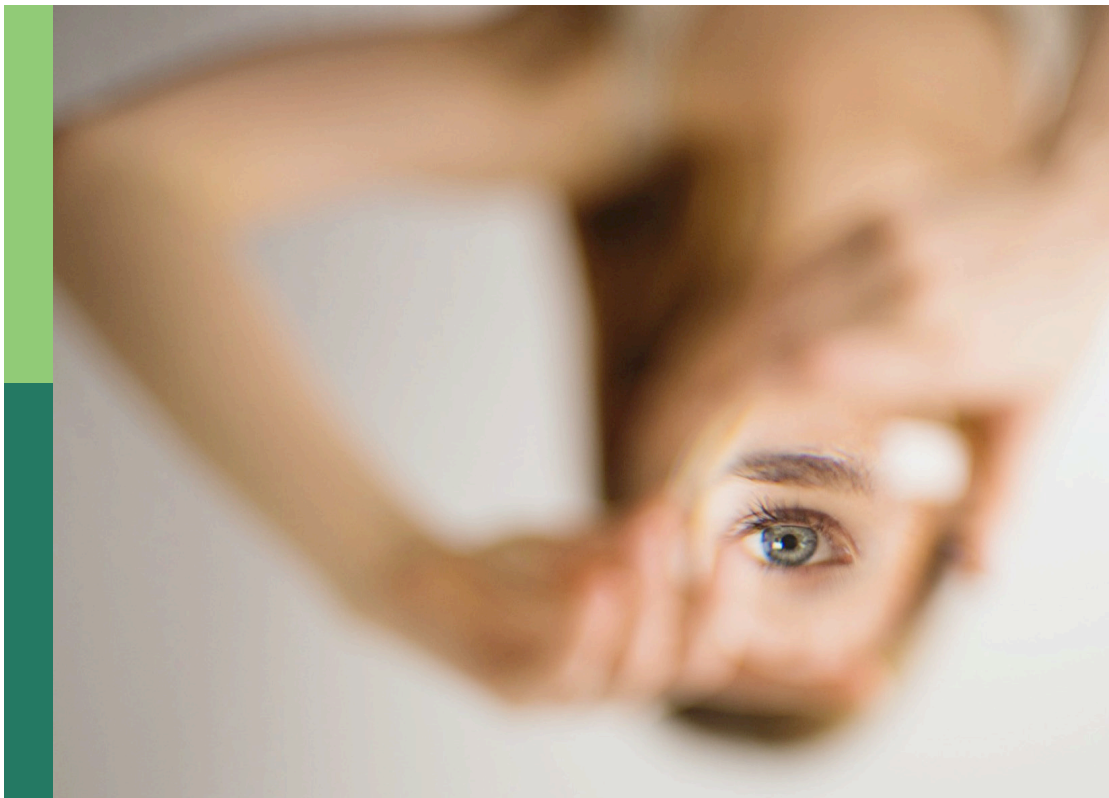

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# What determines green purchase behavior?

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# The impact of interaction on the adoption of electric vehicles: Mediating role of experience value

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The widespread adoption of electric vehicles (EVs) largely depends on the acceptance of the public. Previous studies pay more attention to the factors affecting EV adoption from the customer perspective but lack the perspective of the interaction between sellers and customers. Based on a survey of 1,014 respondents in China, this work developed a research model analyzing the effect of interaction on the intention to purchase EVs and using experience value (EPV) as the mediating variable. The results showed that the functional experience value (FEV) was positively affected by the environment–customer interaction (ECI). The FEV, emotional experience value (EEV), and social experience value (SEV) were all positively affected by salesman–customer interaction (SCI). In addition, they all had positive impacts on purchasing intention (PI). We further analyzed the differences in the interaction between the different business models. Compared with multi-business model car companies, the ECI for single-business model car companies had a more positive impact on the PI. However, the impact of ECI for single-business model companies on PI was negative. The SCI of single-business model car companies positively impacted the PI, whereas the SCI of multi-business model car companies had no significant impact on the PI. These findings provide insight into further understanding the mechanism of interactions affecting EV adoption and help perfect future promotion strategies.

KEYWORDS

**interaction, electric vehicle, purchasing intention, experience value, different business models**

## 1. Introduction

Due to economic expansion and improving living standards, the transportation industry now contributes significantly to worldwide energy consumption and greenhouse gas emissions, i.e., 32 and 25%, respectively (McCollum et al., 2018). In order to achieve the emission reduction goal, Electric vehicles (EVs), mainly pure battery EVs and plug-in hybrid EVs, are becoming increasingly prevalent modes of transport worldwide. Compared with conventional fuel vehicles (CFVs), zero emissions during the EV driving stage can significantly enhance the air quality in cities and mitigate the health risk of tailpipe pollution (Li et al., 2021a,b). Incentive policies to promote EVs have recently been implemented in many countries, such as China, the US, and Europe. These policies mainly comprise financial subsidies (such as vehicle purchase subsidies, purchase tax exemptions, and license fee exemptions) and driving privileges (such as no traffic restrictions and parking fee exemptions). The global EV market is increasing thanks to the above favorable policies; roughly 6 million were sold globally in 2021. However, these sold EVs only account for 9% of total vehicle sales. China has been the world's largest production and sales

market for EVs and the world's largest EV exporter in 2021. Such achievement in China is attributed to the incentive policies of EVs and the purchase restriction of CFVs (e.g., license plate lottery and license plate auction). By the end of 2021, there were 7.84 million EVs in China, but the EV ownership rate was just 3.23% (IEA, 2022). Thus, the low penetration rate of EVs is a significant problem for EV development. Current EV development relies mainly on external stimulation of subsidy policy, but China's subsidy policy is about to be canceled in 2023 (Li et al., 2021a,b). Moreover, China is currently striving to achieve the goal of carbon peaking by 2030 and carbon neutrality by 2060. Therefore, exploring new ways to increase customers' intention to purchase EVs is very crucial.

Previous studies on EV adoption mainly concerned customers' preferences. Benefits of EVs that attract customers include low daily driving costs, quiet driving, strong acceleration, and incentive policies (Li et al., 2020; Mandys, 2021). On the contrary, attributes that make customers resist EVs include high purchase prices, low mileage, long refueling time, insufficient charging stations, and high maintenance cost (Kumar and Alok, 2020). These studies focused on improving the promotion of EVs based on the perspective of customers, but they ignored the problems with EV sales which is also very important for EV promotion. A few studies showed there are some problems during the EV sales process. Due to less profit, many dealers are not motivated to sell EVs (Gerardo et al., 2018), so the perception of the experience of purchasing EVs is worse than CFVs (Cahill et al., 2014). What is more, salespeople lack sufficient knowledge and skills; sometimes they even convey negative viewpoints about the prospects of EVs to customers. A lack of EV models on site to view or test drive is also a common barrier for customers (Matthews et al., 2017). Presently, customers have limited knowledge about EVs, so going to the car shop is one of the effective ways to help them learn more about the advantages of EVs (Gerardo et al., 2018; Yang et al., 2021). The interaction is critical in promoting EVs because it is the final link before customers purchase EVs. In contrast to the usual emphasis on product quality alone, Hong et al. (2020) noted that customers now prefer to increase their intention to purchase through interactive experiences and emotional resonance. Since the commercial marketing layout of EVs becomes thematic, scenario-based, and overlaying, it is necessary to explore the effect of interaction in EV selling (Yang et al., 2021).

In addition, to satisfy the demand for potential car buyers, social media and apps provided by car companies contribute to improving their EV experience. However, the possible effect of these digital platforms on EV selling has not been thoroughly analyzed. Wamuyu (2018) argued that social media are essential for delivering messages related to the promotion of sustainability and social issues, such as environmental protection. De Fano et al. (2022) found that many companies are increasingly using social media to interact with customers and guide them to green consumption to promote the sustainability activities. However, the innovative digital marketing demands a thorough understanding of customers' needs to close the gap between actual and desired shopping experiences (Tupikovskaja et al., 2021). Thus, when analyzing the effect of interaction in EV selling, the online interactions between car companies and customers provided by social media and apps need to be considered.

With the EV market's development, interactions in EV selling differ between companies. Business models of EV companies can be divided into two catalogs: multi-business model car companies and single-business model car companies. The former sells both EVs and CFVs, and the latter sells only EVs. Emerging Chinese car companies in China, such as NIO and Xiaopeng, which are single-business model car companies, have developed new selling methods based on purchasing EVs online and experiencing EVs offline. They have also introduced more scenario-based experiences in offline sales stores (Yang et al., 2021). These sales methods provide more added value for EVs, cater to customers' demands in the era of the experience economy, and achieve excellent results in EV promotion. By contrast, most traditional car companies, which are multi-business model car companies, still follow the traditional 4S store sales method. They have some problems in the sale of EVs and need to improve in sales motivation. Thus, the difference analysis between business models can help better understand the effect of interactions.

This study aims to analyze the effect of interactions on the intention to purchase EVs from the perspective of different business models. Compared with previous studies, the contributions of this study are summarized as follows. First, we defined the interactions in EV selling and highlighted the effect of online interactions on different experience values. Second, we extended the theory of stimulus–organism–response (SOR) model by considering the interactions. Third, we considered the difference in interactions for car companies with multi-business and single-business models. These findings provide new insights for improving customers' intention to purchase EVs and give a reference for formulating EV promotion strategies by policymakers.

The rest of this paper is organized as follows: the conceptual model and hypotheses are presented in the next section; the third section introduces the methods and data sources; the results are presented and discussed in the fourth and fifth sections; and the last section concludes the paper.

# 2. Conceptual model and hypotheses

## 2.1. Research variables

### 2.1.1. Definition of interaction

In early studies, interactions in selling goods are defined as the communication between customers and sellers. Later, customer interactions with the environment and other customers are gradually considered. Svensson (2001) contended that interaction is more than a simple surface-level phenomenon; it requires many components (including interpersonal interaction, environmental interaction, etc.) to be expressed and measured. Li and Fan (2006) proposed an extended interaction model presenting the service interactions between customers and companies, including customers, employees, systems, and physical environments. Chen et al. (2022) categorized interactions during service into three types: communication and interactions between customers and sellers, the environment, and items. In EVs selling, interactions mainly occur between the customer and the environment and between the customer and the salespeople. Specifically, customers interact with the EV environment by looking at the cars in physical stores and browsing EV-related information online. Interactions between the customer and salespeople include discussing EVs and the test drive accompanied by the salespeople. Based on the above, interactions investigated in this study include environment–customer interaction (ECI) and salesman–customer interaction (SCI).

The ECI in previous studies was limited to an offline environment. As the efficiency of interactions was enhanced by technology, Bitner (1992) proposed that when exploring an environment, it should include not only offline visible elements but also online platforms' technological elements, such as electronic services. Thus, in this study, ECI was further classified into online ECI and offline ECI. Online ECI includes customer perceptions of the convenience and esthetics of digital platforms such as apps and websites launched by car companies and the allure of third-party social media for potential EV buyers. Offline ECI describes how the ambiance established by offline EV storefronts might affect customers' views of EVs (Singh and Prashar, 2014). This ambiance includes smell, lighting, facility presentation, cleanliness, and location. Product interaction (PD) and verbal interaction (VB) are two categories of SCI. PD refers to the customer's entire understanding of EVs' efficiency, convenience, and sophistication during the test drive accompanied by the salespeople. VB includes the professionalism, demeanor, and sales skills of the salespeople, as well as the customer's questions, needs, and feedback based on the description of the EV's performance.

It is important to note that both ECI and SCI involve indicators from two distinct categories. The removal of any one indicator would change the concept of the two variables (Jarvis et al., 2003). In reality, customers do not need to engage in all kinds of interactions, because these interactions are not within a common theme and are not highly associated. Specifically, customers might not interact with car companies online, including not using an app or reading social media posts. In addition, there may be no PD between the customer and the salespeople, i.e., only VB and no test drives. So, the characteristics of ECI and SCI were consistent with the concept of formative variables. In other words, the indicators that comprise the formative variable do not necessarily have identical content and cannot be substituted for each other. Therefore, in this study, ECI and SCI were regarded as second-order formative variables based on the conceptual properties of formative variables.

### 2.1.2. Definition of experience value

In the age of experience economies, customer desires are progressively turning toward the spiritual sphere. This change expands and enhances experience theory, resulting in the concept of experience progressively arising in the context of products. Trischler et al. (2018) defined customer experience as a customer journey involving multiple touchpoints and interactions with different actors. Experience provides sensory, emotional, cognitive, behavioral, and relational values. Customers desire and seek experience because experience value is found in the experience and can endure for a long time (Pine and Gilmore, 2013). Sweeney and Soutar (2001) contended that customers' needs in some industries are hierarchical, and thus scholars can establish the correspondence between different needs of customers and different experience values from the vertical, so as to realize hierarchical experience values based on customers' needs. Based on the research on customer experience in the service industry, Li and Fan (2006) uphold Sweeney's perspective and commented that consumers are both emotional and rational, and they require the satisfaction of psychological needs and a sense of belonging while pursuing physical basic needs. Thus, they believed that service experience can be divided into three dimensions: functional, social, and emotional. The hierarchical division method corresponds the experience value to the five levels of needs: physiological needs, security needs, belonging needs, respect needs, and self-actualization, and believes that customers experience satisfaction because the needs at different levels are satisfied (Sweeney and Soutar, 2001). As a result, the hierarchical division method can more accurately reflect the experience value.

Therefore, in this study, we categorized experience value (EPV) as functional experience value (FEV), emotional experience value (EEV), and social experience value (SEV). The FEV corresponds to the satisfaction of customers' functional needs, including the efficiency or convenience of obtaining EV information (Shen et al., 2016). Specific to EVs, FEV is the customer's understanding of performance attributes, development prospects, and EV policy trends during the interaction. EEV refers to the emotions generated during the EV interaction, particularly in identification with the interaction and the ongoing focus on EVs. It specifically refers to customers' feelings about the enthusiasm and sincerity of salespeople, the technical skill of salespeople in selling EVs, and the overall satisfaction with the interactive process. SEV means that customers can get respect and social identity and show their values during the interaction. It refers explicitly to customers believing that purchasing an EV is a green consumption decision, and this behavior can enhance their social image and gain more social recognition (Higueras-Castillo et al., 2019).

## 2.2. Conceptual model

Unlike the Input–Output theory, the expanded SOR (Stimulus-Organism-Response) theory does not discount the significance of intraindividual factors. It adds variables that can express internal perceptions and changes in psychological factors. SOR theory assumes that environmental stimuli cause an individual to experience emotional or cognitive changes, which then affect individuals' subsequent attitudes and behavioral reactions. Therefore, one of the preferred theoretical models for researching customer behavior is the SOR model. In order to understand why customers choose to purchase green products, Wang (2017) built a SOR model based on external risk as a stimulus and customer purchasing intention as a mediating variable. Tak and Gupta (2021) used the SOR model to examine the role of customer engagement in travel mobile device attributes on the customer using intention. The SOR theory assumes that each interaction during a sales process has the potential to enhance, deteriorate, or even destroy a customer's EPV. The EPV may further affect the customers' perception of EVs' performance attributes and service quality, their intention to purchase an EV in this company, and their subsequent purchasing behavior. During the EV selling process, the interactions between car companies with various business models and customers can be understood using interaction theory. Previous studies have demonstrated that interactions can substantially affect individual EPV, which could further affect the purchasing decisions of customers (Shen et al., 2016). Therefore, in this study, we considered that external stimulus referred to interactions, organism referred to the EPV produced during the interactions, and response referred to the customer's intention to purchase EVs. We propose a conceptual model of the effects of interactions on the intention to purchase EVs, as shown in Figure 1.

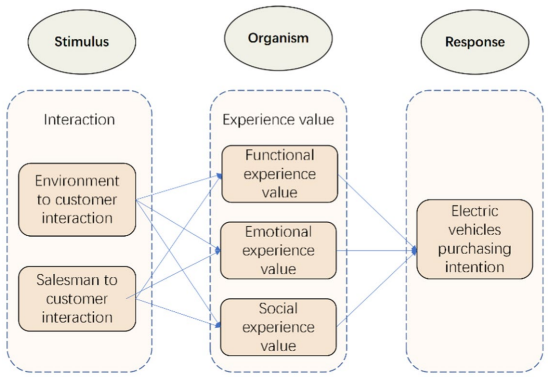


FIGURE 1
Conceptual model.

## 2.3. Hypotheses

### 2.3.1. Impact of interactions on the EPV

(1) Impact of ECI on EPV

The vehicle layout, lighting, scent, and interior displays in sales stores are classified as the interaction environment (Bitner, 1992), and they theoretically contribute to the EPV. Many studies have confirmed that environmental elements significantly affect customers' emotions and purchasing behavior. In addition, Pantano et al. (2021) investigated the impact of time convenience on customer patronage behavior. They showed that time convenience was a determinant of customer choice for shopping location. One of the primary services offered by businesses should be time utility or offering interactions at the appropriate time and location (Gulzari et al., 2022).

In addition to the offline ECI, online ECI also affects the customer experience. Due to their positive effects on the information sharing, brand recognition, and individual engagement, online social media platforms influence every aspect of consumer decision-making (Cao et al., 2021). Companies are gradually developing digital platforms for customer involvement in sustainable behavior (Japutra et al., 2021). According to Lemon, companies that communicate with customers more frequently on digital platforms can affect the customer experience. As a result, ECI no longer occurs only in physical stores; instead, they are more prevalent online. Combining digital and online technologies, these car companies launch digital platforms with unique page layouts, background music, novel short films, and comprehensive services. These measures create a comfortable and harmonious atmosphere and attract customers to immerse themselves in browsing the pages, thus enhancing their EEV (Pantano et al., 2021). At the same time, the more frequently customers interact with online environmental services, the more knowledge and skills they learn about EVs. Thus, the following hypotheses were addressed in this study.

> *H1a*: ECI has a positive effect on FEV.
>
> *H1b*: ECI has a positive effect on EEV.
>
> *H1c*: ECI has a positive effect on SEV.

(2) Impact of SCI on EPV.

In the study of customer service, Groth et al. (2019) found that interaction is central to the experience, and the experiences of customers are determined to some extent by the employees. The interaction process can improve customer–employee fit, which then increases the efficiency and effectiveness of the service according to social dynamics theory (Hong et al., 2020). Customers become more knowledgeable about EVs as the interaction proceeds, which makes it easier for them to reach the cognitive state of being convinced and prepared to purchase. They also perceive the salespeople's enthusiasm and expertise as they converse with them about EVs (Marinova et al., 2017). Positive interactions help customers to develop a closer bond of intimacy and trust with salespeople, which increases EEV. In order to deliver a service that is more specifically tailored to the customer's demands, salespeople promptly solicit feedback from the customer (Su et al., 2007). Customers will also strengthen their SEV because their psychological needs are satisfied, and their feedback is adopted. Thus, the following hypotheses were addressed in this study.

> *H2a*: SCI has a positive effect on FEV.
>
> *H2b*: SCI has a positive effect on EEV.
>
> *H2c*: SCI has a positive effect on SEV.

### 2.3.2. Impact of EPV on the intention to purchase EVs

Along with the consumption upgrading and the product quality demand, the EPV is given a lot of attention. Many studies have provided empirical evidence to support the view that EPV significantly affects consumer purchasing intention and behavior. The value of shopping is provided by the complete shopping experience rather than simply purchasing the product (Pantano et al., 2021). Studies have demonstrated that purchasing behaviors do not always depend on economic rationality; instead, they are primarily motivated by emotions (Groth, 2016). Sensorial and emotional experience increases the value of the use of a product and influences customer satisfaction and the intention in shopping behavior (Japutra et al., 2021; Gulzari et al., 2022). Customers' purchasing intentions (PIs) will be somewhat influenced by their sense of self-worth, social identity, pleasure, and comfort. Thus, this study assumes that the FEV, EEV, and SEV will encourage customers to purchase EVs.

> *H3a*: FEV has a positive effect on the intention to purchase EVs.
>
> *H3b*: EEV has a positive effect on the intention to purchase EVs.
>
> *H3c*: SEV has a positive effect on the intention to purchase EVs.

### 2.3.3. The mediating role of EPV

EPV is created during an interaction and then influences customers' choices. Kim and Choi (2013) found that the service outcome and interaction quality significantly affect customers' experience. In addition, when customers acquire more knowledge and skills about EVs *via* interactions, their functional experience is more

valuable, and they are more likely to purchase EVs (Wang et al., 2018). The customer's EEV in the EV purchasing process is the satisfaction of needs related to identity, belonging, and connection (Shen et al., 2016). Combined with attracting customers, interaction in selling EVs can gradually create emotional resonance. This process facilitates the acceptance of the conveyed messages, including the car company's spiritual concept, leading to EV purchases. Thus, the following hypotheses were proposed.

> *H4a*: EPV plays a mediating role in the effect of ECI on the intention to purchase EVs.
>
> *H4b*: EPV plays a mediating role in the effect of SCI on the intention to purchase EVs.

#### 2.3.4. Different business models

Car companies with diverse business models have different interactions with their customers. Most traditional car companies with multi-business models have relatively remote dealerships in suburban areas (Cenglin, 2012). They generally lack to consider how to improve the arrangement, lighting, fragrance, interior displays, and other aspects of the selling environment. According to previous studies, the poor profit margin of EVs, the unavailability of EV models in sales outlets, and the high time cost of marketing EVs make traditional car companies frequently lack the initiative to offer EVs to customers (Matthews et al., 2017). In addition, the apps provided by numerous multi-business automobile companies give a terrible user experience with little or no customer usage, and they do not engage with customers anywhere and anytime.

By contrast, customers of car companies with a single-business model get experiences from four aspects: products, services, digital contacts, and lifestyle (Yang et al., 2021). These experiences help customers develop a deep brand relationship with car companies. The most typical example is Tesla, which chose a direct-sales model in which its vehicles are sold at fixed prices online or through factory-owned stores and service centers (Cahill et al., 2014). In addition, this car company leads customers to aspire to intelligent driving technologies, which provide customers with a better experience. Thus, the following hypothesis was addressed in this study.

> *H5a*: There are differences in the impacts of interactions on the EPV and PI for car companies with different business models.

## 3. Methods and materials

### 3.1. Methods

Partial least squares structural equation modeling (PLS-SEM) combines principal component analysis with multiple regression analysis, and it has advantages when dealing with complex causal relationships. In this study, we adopted PLS-SEM because of the following reasons. First, the PLS-SEM model can handle the problem of non-normally distributed data. In contrast, the classic covariance-based structural equation modeling (CB-SEM) assumes that all observations follow a multivariate normal distribution. The sales contract, experience value, and purchasing intention observations used in this study did not follow a normal distribution. Thus, the CB-SEM cannot be used to analyze the variables. Second, ECI and SCI are second-order formative variables, and the CB-SEM cannot handle formative indications. Third, we aimed to integrate hypothesis testing to determine how interactions affected the intention to purchase EVs through experience value according to the SOR model. Therefore, the PLS-SEM approach was a suitable choice for evaluating the factors that might influence the intention of customers to purchase EVs in this study.

### 3.2. Materials

A questionnaire was used as a measurement tool in this study, and the design of it came from questionnaires successfully used in previous studies (see Appendix Table A.1). Before the formal distribution of the questionnaire, the authors selected 20 colleagues or friends who were about to purchase an EV for a pre-survey. Some minor linguistic adjustments and modifications were made to ensure that the participants could comprehend the meaning of each question. We selected six cities (Beijing, Shanghai, Tianjin, Chongqing, Shenzhen, and Hangzhou) to distribute the questionnaire, and they belong to the national EVs promotion demonstration cities. These cities have the following advantages compared to other cities in China: First, there are more EV sales stores and complete supporting facilities. Second, EVs have more online promotion and diversified sales methods in these cities. Third, more potential customers in these cities have experienced EVs online and offline. Questionnaire Star is a professional questionnaire distribution company that we commissioned to distribute online questionnaires in these six cities. At the same time, we went to sales stores in these cities and invited customers to scan the QR (Quick Response) code and fill in the questionnaire.

The target population is those who have had a complete online and offline car viewing or purchasing experience with a car company within 6 months. The complete online and offline experiences include browsing information about EVs on social media and car company apps, seeing EVs in a sales store, and having a test drive experience. Therefore, we set questions such as "Have you seen electric vehicles in an offline sales store within six months?" to find the target population. In the end, we collected 4,485 questionnaires (including 2,871 online and 1,614 offline questionnaires), leaving 1,014 valid questionnaires after eliminating invalid ones. According to Hair et al. (2011), minimum sample size should be equal to the larger of the following: (1) ten times the largest number of formative indicators used to measure one construct or (2) ten times the largest number of structural paths directed at a particular latent construct in the structural model. Therefore, the sample size of this study needs to be larger than 60 and 1,014 meets the requirements. The socio-demographic characteristics of participants are reported in Table 1. In order to know what kind of business model the car company is, we provided a selection of the 16 top-selling electric car companies in China for participants and a fill-in-the-blank item. If the 16 options did not contain the car company the participant expected, participants could fill in the blank item with the company they expected. After that, we judged which business model one car viewing experience belongs to according to the car company.

Furthermore, the participants rated their level of agreement for several questions on a scale from 1 (strongly disagree) to 7 (strongly agree). Regarding the survey architecture development, the questions were randomized for each participant to reduce question order bias. In contrast, some questions with a defined response were inserted to avoid attention issues during the investigation.

## 4. Results

Statistical analyses of the data collected in this study were conducted using SPSS 26 and PLS-SEM 3. The data were examined to assess the sampling adequacy (KMO test) and data normality (Bartlett's test of sphericity). The KMO score was 0.927, which exceeded the threshold of 0.70. Bartlett's measure was also highly significant ($p < 0.001$). Thus, the data did not conform to the assumption of the independence of variables. The data collected using the questionnaire were well-structured and appropriate for factor analysis. The PLS-SEM model evaluation process had two stages. The outer model was first examined and assessed by its type. In the case of reflective measurement models, it is necessary to assess the reliability, convergent validity, and discriminant validity of indicators and constructs. For formative measurement models, it is necessary to assess the significance and relevance of the external weights of the indicators and multicollinearity. Thus, the capacity of each measurement indicator to explain the variables was determined. In the second stage, the inner model was examined by focusing on the path coefficients, the explanatory ($R^2$), and the predictive ($f^2$) capabilities. The effects of the interactions between car companies and customers on the intention to purchase EVs under different business models were then examined using multiple group analysis (MGA-PLS).

TABLE 1 Sample information ($N$=1,014).

| Demographics | | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 611 | 60.3 |
| | Female | 403 | 39.7 |
| Age | 18–25 | 159 | 15.7 |
| | 26–30 | 366 | 36.1 |
| | 31–35 | 281 | 27.7 |
| | 36–45 | 142 | 14 |
| | 46–55 | 57 | 5.6 |
| | 55 and over | 9 | 0.9 |
| Education | Middle School and below | 21 | 2.1 |
| | High School | 121 | 11.9 |
| | Junior college | 248 | 24.5 |
| | Undergraduate | 561 | 55.3 |
| | Postgraduate and above | 63 | 6.2 |
| Family annual income | Less than ¥100,000 | 122 | 12 |
| | ¥100,000–¥200,000 | 398 | 39.3 |
| | ¥200,000–¥300,000 | 314 | 31 |
| | ¥300,000–¥400,000 | 107 | 10.6 |
| | ¥400,000–¥500,000 | 30 | 3 |
| | More than ¥500,000 | 43 | 4.2 |

### 4.1. Outer model analysis

Some mature scales were contextualized in constructing the outer model, and certain variables were not considered in previous research. For this reason, it was essential to verify the questionnaire's validity before assessing the outer model's reliability. The consistency of the test items inside the variables was assessed based on the composite reliability (CR) and Cronbach's alpha (Cronbach's α). It is generally accepted that CR > 0.7 and Cronbach's α > 0.7 indicate that the observed items are strongly linked with the variables.

In the outer model, measures used to assess the same latent variable are located at the same latent factor level, known as the outer model's convergent validity. Standardized factor loadings for the observed indicators >0.5, average variance extracted (AVE) > 0.5, and CR > 0.7 are typically used to measure the convergent validity (Fornell and Larcker, 1981). As shown in Table 2, the AVE values ranged from 0.604 to 0.877, and the standardized factor loadings for all 28 assessed questionnaire items were 0.757, demonstrating the high convergent validity of the variables.

The cross-loading matrix (cross-loading) and the Fornell–Larcker criterion demonstrated the discriminate validity of the SEM. Appendix Table B.1 shows that the variable's factor loading for each questionnaire item was higher than its factor loading for the other variables (factor loading > cross-loading). In addition, the results of Table 3 indicated that the AVE value of each variable exceeded the square root of the correlation between the variable and the other variables, following the Fornell–Larcker criterion (Fornell and Larcker, 1981).

Formative variables were assessed to determine the validity of the indicators with outer weights >0.2. The significance was calculated for the coefficients of the indicators ($t > 1.96$ and $p < 0.01$) using the bootstrap resampling method by drawing 5,000 samples. The outer weights were more than 0.4 for each indicator, as shown in Table 4, and were statistically significant ($p < 0.01$). The issue of covariance among formative indicators was also considered, i.e., variance inflation factor (VIF) < 3.3 (Thongrattana, 2010). The two formative variables related to SCI and ECI had VIFs of 1.956 and 2.334, respectively, which were below the threshold of 3.3 and were not affected by the covariance issue.

### 4.2. Inner model analysis

The PLS algorithm approach was utilized to assess the fits of the explanatory factors to the predictions of the outcome variables. Bootstrap iterative sampling was used to draw 5,000 samples for

TABLE 2 Model results of SFL, CA, CR, and AVE.

| Variable | Item | Standardized factor loading (SFL) | Cronbach's Alpha (CA) | Composite reliability (CR) | Average variance extracted (AVE) |
|---|---|---|---|---|---|
| ECI_ON | ECI_ON1 | 0.784 | 0.796 | 0.867 | 0.620 |
| | ECI_ON2 | 0.776 | | | |
| | ECI_ON3 | 0.795 | | | |
| | ECI_ON4 | 0.795 | | | |
| ECI_OF | ECI_OF1 | 0.814 | 0.697 | 0.832 | 0.623 |
| | ECI_OF2 | 0.786 | | | |
| | ECI_OF3 | 0.766 | | | |
| SCI_PD | SCI_PD1 | 0.838 | 0.760 | 0.862 | 0.676 |
| | SCI_PD2 | 0.816 | | | |
| | SCI_PD3 | 0.811 | | | |
| SCI_VB | SCI_VB1 | 0.780 | 0.796 | 0.867 | 0.620 |
| | SCI_VB2 | 0.781 | | | |
| | SCI_VB3 | 0.799 | | | |
| | SCI_VB4 | 0.789 | | | |
| FEV | FEV1 | 0.763 | 0.781 | 0.859 | 0.604 |
| | FEV2 | 0.801 | | | |
| | FEV3 | 0.757 | | | |
| | FEV4 | 0.787 | | | |
| EEV | EEV1 | 0.946 | 0.954 | 0.966 | 0.877 |
| | EEV2 | 0.931 | | | |
| | EEV3 | 0.940 | | | |
| | EEV4 | 0.929 | | | |
| SEV | SEV1 | 0.933 | 0.921 | 0.954 | 0.875 |
| | SEV2 | 0.927 | | | |
| | SEV3 | 0.945 | | | |
| PI | PI1 | 0.901 | 0.884 | 0.928 | 0.812 |
| | PI2 | 0.899 | | | |
| | PI3 | 0.903 | | | |

ECI_ON, online environment-customer interaction; ECI_ON1, the first item in the online environment-customer interaction; ECI_OF, offline environment-customer interaction; SCI_PD, product interaction in salesman-customer interaction; SCI_VB, verbal interaction in salesman-customer interaction; FEV, functional experience value; EEV, emotional experience value; SEV, social experience value; PI, purchasing intention.

TABLE 3 Discriminant validity and the correlations.

| | ECI_ON | ECI_OF | SCI_PD | SCI_VB | FEV | EEV | SEV | PI |
|---|---|---|---|---|---|---|---|---|
| ECI_ON | 0.787 | | | | | | | |
| ECI_OF | 0.604 | 0.789 | | | | | | |
| SCI_PD | 0.566 | 0.578 | 0.822 | | | | | |
| SCI_VB | 0.560 | 0.637 | 0.665 | 0.787 | | | | |
| FEV | 0.551 | 0.531 | 0.600 | 0.614 | 0.777 | | | |
| EEV | 0.129 | 0.138 | 0.147 | 0.256 | 0.113 | 0.936 | | |
| SEV | 0.110 | 0.128 | 0.129 | 0.194 | 0.106 | 0.864 | 0.935 | |
| PI | 0.294 | 0.300 | 0.367 | 0.385 | 0.411 | 0.067 | −0.015 | 0.901 |

The diagonal is the root value of AVE, and the lower triangle is the Pearson correlation.
ECI_ON, online environment-customer interaction; ECI_ON1, the first item in the online environment-customer interaction; ECI_OF, offline environment-customer interaction; SCI_PD, product interaction in salesman-customer interaction; SCI_VB, verbal interaction in salesman-customer interaction; FEV, functional experience value; EEV, emotional experience value; SEV, social experience value; PI, purchasing intention.

computing and evaluating the parameters relevant to the model coefficients. The results indicated that FEV, EEV, and SEV had $R^2$ values of 0.48, 0.39, and 0.31, respectively. Thus, interactions predicted FEV more accurately than EEV and SEV values. The effect size ( $f^2$ ) has a minimum cutoff value of 0.02, which was used to quantify the impact of eliminating a specific latent variable on the endogenous variable. According to Table 5, the indicator of the predictive effect of the explanatory variable ECI on the outcome variable FEV was 0.066, and thus, higher than the minimum threshold. The indications of the predictive effects of SCI on FEV, EEV, and SEV ranged from 0.035 to 0.210, and all were higher than the minimum threshold. The predictive effects of FEV, EEV, and SEV on purchase intention are in the range of 0.028 to 0.207, which is a good prediction effect. Cross-validation was conducted (Henseler, 2009) to further assess the stability and fitness of the model, and the results ranging from 0.045 to 0.816 demonstrated the model's validity. Additionally, the overall model standardized root mean square residual (SRMR) of 0.059 satisfied the requirement of SRMR $< 0.08$ (Henseler et al., 2016), demonstrating the model's fitness.

The following results can be summarized based on Table 5. First, the path coefficients of 0.265 and 0.475, respectively, confirmed hypotheses H1a and H2a by showing that ECI and SCI had considerable positive effects on FEV. SCI was more effective than ECI regarding how much each variable influenced FEV. The effect of ECI on EEV and SEV failed to pass the significance test. By contrast, the beneficial impacts of SCI on EEV and SEV were more significant, with path coefficients of 0.261 and 0.186, respectively, thereby supporting hypotheses H2b and H2c. FEV, EEV, and SEV significantly affected the purchasing intention, with path coefficients of 0.411, 0.281, and 0.301, respectively, thereby supporting hypotheses H3a, H3b, and H3c.

TABLE 4 Outer weights of interaction construct and their significance.

| | Outer weights | STDEV | \|O/STDEV\| | *p* value |
|---|---|---|---|---|
| ECI_ON - > ECI | 0.589 | 0.072 | 8.152 | 0.000 |
| ECI_OF - > ECI | 0.529 | 0.075 | 7.025 | 0.000 |
| SCI_PD - > SCI | 0.414 | 0.069 | 5.956 | 0.000 |
| SCI_VB - > SCI | 0.676 | 0.068 | 9.947 | 0.000 |

ECI_ON, online environment-customer interaction; ECI_ON1, the first item in the online environment-customer interaction; ECI_OF, offline environment-customer interaction; SCI_PD, product interaction in salesman-customer interaction; SCI_VB, verbal interaction in salesman-customer interaction; STDEV: standard deviation.

## 4.3. Intermediary testing

The mediation effect test protocol was employed to evaluate the mediating effect of EPV (Zhao et al., 2010). In total, 5,000 samples were used, and the significance of the mediating impact was determined by assessing whether the 95% confidence interval of the indirect effect included 0. According to the results (see Table 6), the EPV was a significant mediating factor for the effect of ECI on PI. The mediating effects of FEV, EEV, and SEV were all significant, with indirect effects of 0.339, 0.067, and 0.069, respectively. The overall effect of EPV on mediating the effect of SCI on PI was also significant. All three EPV types had significant mediating effects. However, the mediating effect of FEV was smaller than before, with 0.277, whereas the effects of EEV and SEV were more significant than those under ECI, with 0.086 and 0.083, respectively. The amplitudes of the path impacts of the three mediating factors were then compared. Compared with the mediating effects of ECI and SCI on PI, the mediating effect of FEV was much more significant than those of EEV and SEV.

## 4.4. Multi-group analysis

The Multi-group analysis is used to determine the presence and significance of differences by estimating the parameters (path coefficients) for predefined groups within a sample (Hair et al., 2017). If the value of p for the difference in the group path coefficients was less than 0.05 or more than 0.95, a parametric test and the MGA-PLS approach are needed to identify significant differences (Hair et al., 2014). We used this technique to investigate how different business models were affected by ECI and SCI.

TABLE 5 Structural model results and effects sizes ( $f^2$ ).

| Criterion variable | Predictor variable | H | Path coefficient | STDEV | T | $f^2$ | Conclusion |
|---|---|---|---|---|---|---|---|
| FEV | ECI | H1a | 0.265*** | 0.050 | 5.320 | 0.066 | Support |
| | SCI | H2a | 0.475*** | 0.053 | 8.881 | 0.210 | Support |
| EEV | ECI | H1b | −0.038 | 0.044 | 0.860 | 0.001 | Not Support |
| | SCI | H2b | 0.261** | 0.047 | 5.544 | 0.035 | Support |
| SEV | ECI | H1c | −0.001 | 0.043 | 0.023 | 0.000 | Not Support |
| | SCI | H2c | 0.186*** | 0.046 | 4.061 | 0.018 | Support |
| PI | FEV | H3a | 0.411*** | 0.041 | 10.090 | 0.207 | Support |
| | EEV | H3b | 0.281*** | 0.079 | 3.534 | 0.025 | Support |
| | SEV | H3c | 0.301*** | 0.076 | 3.962 | 0.028 | Support |

*$p < 0.10$. **$p < 0.05$. ***$p < 0.010$. Pearson correlation, two-tailed.
ECI, environment-customer interaction; SCI, salesman-customer interaction; FEV, functional experience value; EEV, emotional experience value; SEV, social experience value; PI, purchase intention; STDEV, standard deviation.

According to the results obtained by multi-group analysis (Table 7), the effects of ECI and SCI on PI varied greatly under two business models. The effect of ECI on FEV was considerable under single and multiple business models, but the single-business model had a more substantial positive effect. Under both business models, the impacts of ECI on EEV and SEV were negative or insignificant. In addition, SCI significantly increased FEV, EEV, and SEV under the single-business model. By contrast, SCI only significantly increased FEV under the multi-business model. The effect of SCI on EEV varied greatly depending on the model. EEV and SEV only passed the test under the single-business model, and the difference between the effects of the two models was significant. The effect of FEV on the intention to purchase EVs was significant under both business models.

# 5. Discussion

The intention to purchase EVs is crucial for anticipating the market size and consumption patterns. This study obtained sufficient theoretical and empirical support for the classification of interactions based on two dimensions: ECI and SCI. These two dimensions are based on the connotations and dimensions of interactions between car companies and customers in two business models. In addition, our findings provide new insights into how salespeople traits and online market circumstances affect the final effect of interactions on the purchase of EVs.

## 5.1. General discussion

In Section 4, we showed that there is an impact of ECI and SCI on EPV, so we further discussed the impact of each of the two dimensions of ECI (online ECI and offline ECI) and SCI (PD and VB) on EPV. The results obtained in this study demonstrated (see Appendix Table C.1) that online ECI had a significant impact on FEV ( $\beta = 0.156, \rho < 0.01$ ). This finding indicates that customers' functional needs were satisfied, and they could access detailed information (such as usage instructions) through the official website and the car company's app. Nöjd et al. (2020) also found that digital technology can support customers' desires and enhance their experience. However, online and offline ECI had little effect on EEV and SEV, possibly because it takes longer to nurture and instill emotional and social values. In addition, ECI is less adaptable than SCI at detecting customers' emotional states, preventing customer unhappiness, and boosting customer contentment.

TABLE 6 Bootstrap analysis of the intermediate effects test.

| Mediating effect | ECI→EV→PI | | | SCI→EV→PI | | |
|---|---|---|---|---|---|---|
| | Effect | 95% confidence intervals | | Effect | 95% confidence intervals | |
| | | Lower | Upper | | Lower | Upper |
| FEV | 0.339 | 0.232 | 0.462 | 0.277 | 0.160 | 0.408 |
| EEV | 0.067 | 0.026 | 0.126 | 0.086 | 0.028 | 0.157 |
| SEV | 0.069 | 0.028 | 0.129 | 0.083 | 0.036 | 0.151 |
| Total effect | 0.475 | 0.286 | 0.717 | 0.446 | 0.224 | 0.716 |
| Comparison of mediating effects | | | | | | |
| FEV/EEV | 0.272 | 0.141 | 0.399 | 0.191 | 0.042 | 0.338 |
| FEV/SEV | 0.270 | 0.293 | 0.489 | 0.194 | 0.056 | 0.347 |
| EEV/SEV | −0.002 | −0.023 | 0.110 | 0.003 | −0.042 | 0.134 |

ECI, environment-customer interaction; SCI, salesman-customer interaction; FEV, functional experience value; EEV, emotional experience value; SEV, social experience value; EV, experience value; PI, purchasing intention.

TABLE 7 Impact of environmental and interpersonal interactions on purchase intention of EVs under different business models.

| | Path Coefficients (single) | STDEV (single) | t (single) | Path Coefficients (multiple) | STDEV (multiple) | t (multiple) |
|---|---|---|---|---|---|---|
| ECI - > FEV | 0.375*** | 0.071 | 5.269 | 0.184*** | 0.056 | 3.281 |
| ECI - > EEV | −0.251*** | 0.065 | 3.863 | 0.101 | 0.066 | 1.543 |
| ECI - > SEV | −0.112 | 0.063 | 1.787 | 0.073 | 0.062 | 1.170 |
| SCI - > FEV | 0.395*** | 0.069 | 5.727 | 0.541*** | 0.063 | 8.622 |
| SCI - > EEV | 0.484*** | 0.068 | 7.145 | 0.124 | 0.067 | 1.857 |
| SCI - > SEV | 0.293*** | 0.066 | 4.456 | 0.114 | 0.065 | 1.760 |
| FEV - > PI | 0.427*** | 0.055 | 7.823 | 0.401*** | 0.055 | 7.322 |
| EEV - > PI | 0.493*** | 0.111 | 4.435 | 0.154 | 0.105 | 1.464 |
| SEV - > PI | 0.514*** | 0.104 | 4.958 | 0.182 | 0.103 | 1.765 |

ECI, environment-customer interaction; SCI, salesman-customer interaction; FEV, functional experience value; EEV, emotional experience value; SEV, social experience value; PI, purchasing intention.

SCI had beneficial effects on FEV ( $\beta = 0.197, \rho < 0.01$ ), EEV ( $\beta = 0.108, \rho < 0.01$ ), and SEV ( $\beta = 0.077, \rho < 0.01$ ), which suggested that experiencing EVs could effectively help them to understand the benefits of EVs. This process reduced their psychological anxieties, increased their enjoyment, and raised their environmental consciousness about purchasing an EV. Similarly, Shen et al. (2016) demonstrated the importance of co-creating PD with customers. VB had the best effect on FEV ( $\beta = 0.321, \rho < 0.01$ ), EEV ( $\beta = 0.176, \rho < 0.01$ ), and SEV ( $\beta = 0.126, \rho < 0.01$ ). Thus, developing online and mobile platforms can significantly improve customers' understanding of EVs, but salespeople still play a crucial role in the interaction process. The salespeople's technical expertise and service attitude can significantly influence the customer's perception and PI. Higueras-Castillo et al. (2019) believed that the sale force should provide more information explaining the product performance. Gerardo et al. (2018) also found that the most significant factors that influenced the purchasing intentions of prospective purchasers were the salespeople's enthusiasm and their knowledge of EVs.

In addition, SEV, EEV, and FEV significantly impacted the intention to purchase EVs. It indicates that recognition of the functional value of EVs, a positive emotional experience of viewing a car, and social recognition can increase the willingness to purchase an EV. A good functional experience enhances the practical and functional value of users, thus increasing their purchasing intention; while a good emotional experience enhances the enjoyment and emotional value of users, thus also increasing their purchasing intention (Yang et al., 2021). Furthermore, SEV, EEV, and FEV had mediating roles in the impacts of interactions on the intention to purchase an EV. The mediating effect of FEV was much more significant than those of EEV and SEV. Therefore, the more FEV customers generate during interactions, the more likely they are to purchase an EV.

When considering the business models, the results are further discussed. The positive effect of ECI on FEV was more significant for single-business model car companies. This result supports the phenomenon that not all car companies can successfully promote their products through live events or other online activities (Habich-Sobiegalla et al., 2019). Many car companies with multi-models face problems such as underdeveloped mobile platforms and amateurish Internet sales platforms. The impact of ECI on EEV for single-business model companies is negative. These companies, such as BYD, Tesla, and Xiaopeng, account for most EV sales in the Chinese market. However, they generally have problems such as long pickup cycles and uncertain waiting times. These single-business model car companies often offer a complete online car purchase service that displays an estimated delivery date after the customer has selected their desired car. Some have delivery dates as high as 3 to 5 months, which inevitably leads to a bad experience. In our sample, BYD, Tesla, and Xiaopeng accounted for 34.5, 16, and 8.9% of the sample. Therefore, people in the sample who had experienced or purchased EVs from these car companies should be aware of this pickup cycle problem. The salespeople often deliberately avoid informing customers about the long vehicle delivery lead time, so this factor played a minor role in the impact of SCI on EEV. At the same time, most of the apps of single-business model car companies integrate a variety of segments such as car purchase, car use, car maintenance, social, and e-commerce. Most customers only use a few segments, and too many segments can affect customers' browsing experience. In addition, some car companies deliberately filter out negative comments in the community section of the app. Too many positive or praising comments could make customers question the platform's authenticity and create resistance. All of these are reasons why ECI has a negative impact on consumers' EEV. The effects of SCI on EEV and SEV failed the test for the multi-business model car companies, indicating that the salespeople in these companies did not aggressively guide customers to concern EVs. They also did not fully promote the social symbol of driving EVs, such as pro-environment identification. These barriers made it challenging for customers to acquire knowledge of EVs following interactions. Thus, they did not feel satisfied and happy since the product would meet their expectations. This explains why EEV and SEV did not significantly affect PI in the multi-business model company.

## 5.2. Practical implications

Given the different effects of sales interactions for car companies with two business models, some suggestions are provided. First, to maximize the experience value, car companies could continuously update and develop the functions of the online mobile platforms and strive to provide timely and convenient interactions to customers. Before purchasing an EV, customers can require comprehensive and adequate information (such as high-tech features) from the automobile industry. Second, it is necessary to increase the professionalism of salespeople by enhancing their knowledge and expertise in marketing EVs. Salespeople should be able to respond to customers' questions about EVs. In addition, they should present a positive outlook on purchasing an EV by emphasizing the prosocial qualities and environmental benefits. This can enhance the customers' recognition and correct their ingrained perceptions of EVs. Last, the online ECI of single-business car companies has not been able to meet customers' emotional and social needs; so, some online services should be improved. Car companies could analyze the different categories of customers and tailor the style and contents of their interactions to meet their specific needs. For example, push customized content for different groups on the app.

The results in this study can provide a basis and reference for policymakers to develop EV-promoting strategies. First, given that some customers lack sufficient knowledge about EVs, the government could actively promote and popularize EV-related information (such as vehicle performance, environmental benefits, and high-level intelligence) on digital platforms. This measure could encourage society to purchase EVs and foster green travel concepts. Second, to ensure customers have a thorough and understandable grasp of EV incentive policies, the government could present EV-related policies in a form that customers can comprehend on the leading mobile platforms. Third, more chances can be provided for customers to get in touch with EVs. For example, the government could encourage car companies to organize face-to-face activities of EVs in the experience center. This can make potential customers gain a deeper understanding and

experience of EVs through interactions (such as explanations by salespeople and test drives). Finally, the government could guide the training of specific EV-related employees and accelerate the transformation of car salespeople. They should be able to comprehend the benefits and traits of EVs and encourage customers to have faith in EVs.

## 6. Conclusion and future research

The interaction between sellers and customers is significant for promoting EVs but generally attaches little attention in previous studies. In this study, we explored how interactions influence the intention of customers to purchase EVs. We also identified the differences in the interactions among car companies with two business models. The following results were obtained by modeling the data collected from a large-scale survey in China. First, ECI had a positive effect on FEV but no significant effects on EEV and SEV. SCI had a positive effect on three dimensions of EPV. Second, FEV, EEV, and SEV all positively affected PI. Finally, we looked at interactions of two business model car companies. ECI of single-business model car companies had a significant positive effect on FEV, but there was a significant negative effect on EEV and SEV. However, the impact of SCI on FEV, EEV, and SEV for single-business model car companies is positive. Furthermore, the ECI and SCI of multi-business model car companies positively affected FEV, but the effects on EEV and SEV were insignificant. The study revealed the effect of interactions by car companies with different business models and discussed the challenges, opportunities, and emerging trends in China's EV market. It provides a new perspective for EV car companies and the government to promote EVs after the subsidy policy has been withdrawn.

We obtained some insightful results in this study, but further studies are still needed. We only used data from China, which could limit the broader application of our results. Future studies could use data from more countries to confirm the reliability of our results. In addition, the sample data used for the analysis in this study were cross-sectional or static data from a specific period. Thus, it was impossible to detect changes in customers' intentions to purchase EVs over time. In conclusion, a follow-up study could use a longitudinal design method with regular monitoring and validation to produce more accurate and scientific results.

## Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

## Author contributions

WL and RL developed the original idea for this article. XC designed the experiment. WL and MW analyzed the results and wrote the paper. All authors have read and agreed to the published version of the manuscript.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1129752/full#supplementary-material

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# Understanding sustainable purchase intention of smartphone users interface: Evidence from China

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In recent decades, the fast development of smartphones has resulted in an enormous mass of e-waste besides a carbon footprint increase. In the face of serious environmental concerns, the manufacture and disposal of smartphones have become a primary customer concern. Environmental concerns are becoming a decisive factor when it comes to purchasing a product. Manufacturers have shifted their focus to product design with sustainable requirements in response to these new customer requirements. With all of the affordable technology manufacturers now may consider customer-sustainable requirements. This research aims to examine the relationship between traditional customer requirements, sustainable customer requirements, and sustainable purchase intention for smartphones in China, as well as the mediation effect of sustainable perceived value and the moderation effect of price sensitivity. Customers' preferences are determined by using an online questionnaire. This research proposed an advanced sustainable purchase intention model by conducting an empirical analysis of the data gathered from 379 questionnaires. To gain a competitive advantage, companies should concentrate on meeting traditional and sustainable requirements more than the product price, according to the findings of the research. And contributes to the segmentation of the eco-friendly smartphone market.

KEYWORDS

**purchase intention, sustainable design, sustainable requirements, traditional requirements, sustainable perceived value, price sensitivity**

## 1. Introduction

Rapid advances in technology in the 21st century have greatly impacted human lifestyles with a bevy of devices, technologies, and systems being integrated into humans life-changing the very fabric of society to an unprecedented extent. Asian countries in particular, due to fast-paced growth have been quick to adopt new technologies and incorporate them into their daily lives. Smartphones in particular have been immensely popular, integrating and transforming every aspect of life in Asian societies, ranging from being used for everything from personal to business activities in Asian countries with some level of industrialization (Wei et al., 2018). Gartner carried out surveys and found that, in the first quarter of 2021, smartphone sales globally exceeded 1.5 billion units, hitting a growth rate of 11.4% compared to last year's data (Gartner, 2021). China has remained the world's largest smartphone users since. In 2021 smartphone users in China reached over 911.92 million, accounting for about 66% percent of the total population in China (Statista, 2021).

Personal electronic devices' rise and monumental growth have also seen a corresponding increase in humanity's already formidable carbon footprint. Additionally, the life cycle of smartphones is limited due to advancements in functionality and features, as well as changes in people's preferences. Due to shorter product cycles, phones get replaced consistently, and discarded smartphones become hazardous e-waste, contributing to environmental degradation as well as detrimental to human health (Kempen and Betzler, 2021). The United Nations "2020 Global E-waste Monitoring Report" stated that a staggering 53.6 million metric tons of e-waste were accumulated all around the world in 2019, up 21 percent in just 5 years – the highest increase among all types of other waste, with recycling tackling only 17.4% of it. The other 82.6% either ends up in landfills, is incinerated, resold, or repurposed through inappropriate channels and methods. Asia is the largest producer of e-waste. China ranked first, in terms of countries, then Japan and India in e-waste production, and this has become an urgent threat to China's sustainable development. In 2020, over 2.7 million tons of e-waste were generated with the prediction for 2030 at an exponentially higher 81 million tons (GEM, 2018, 2020). Lead, lithium, mercury, and cadmium are among the highly processed and nearly inseparably amalgamated elements found in e-waste, which, if not handled properly will be the cause of substantial environmental degradation as well as a threat to human health (Tu et al., 2018).

The central focus of sustainable design is to design and produce products in a manner that is relatively more environmentally friendly while also being sensitive to the expectations of consumers and market sentiment. Product design has changed significantly from being concerned with traditional customer requirements like performance, shape, and easy-to-use, to sustainability considerations (social, economic, and environmental requirements) in the design process. The concept of sustainability in a product's design philosophy is to balance environmental, economic, and social elements in the design of products and services. Indeed, sustainable product design is closely linked to the concept of sustainable Purchase Intention to minimize negative impacts and maximize positive impacts (Wang and Hsu, 2019).

In response, sustainable Purchase Intention is rapidly getting attention and traction, as a manifestation of the desire for people to pursue healthy lifestyles and choices with less destructive outcomes for the environment. Increasing public awareness of sustainability is leading to a corresponding rise in consumer purchasing decisions perceived as responsible. Environmental concerns have led to the identification of a new segment of consumers who care about the environment which is reflected in their purchasing decisions (Wang et al., 2021). Customer behavior is shifting toward awareness of environmental effects, to the point that some are even ready to pay more for sustainable product design products where effort has been made to reduce detrimental environmental impact (Tu et al., 2018). As an outcome, green development and sustainable purchasing have become trending issues of the time, Purchase Intention has been studied by several academics. Despite the fact that there have been major studies on this topic, there are significant gaps in the academic literature that need to be filled.

Research scholars have increasingly focused their attention on sustainable behavior with an emphasis on demographic variables through which the behavior of people towards sustainable Purchase Intention can be influenced (Al Mamun et al., 2018), and show that there are significant differences in the sustainable behavior of different consumers characteristics but other scholars believe that considering the demographic is not enough to reach a meaningful valuable conclusion, this has opened new perspectives on Purchase Intention. Therefore Scholars interested in the psychological variables of sustainable behavior have begun to explore consumers' perceived values (Tu et al., 2018; Wang and Hsu, 2019). Consumers have strong opinions regarding different aspects of Smartphones revolving around connotations, information, and services. Additionally, functional, social, and emotional values also have an impact on the relationship between sustainable requirements, traditional requirements, and purchase intention, with such relationships expected to lead to more consumer-aware design (Wang and Hsu, 2019). Besides the influence of demographic variables on customer purchase intentions, this study attempts to examine how perceived value influences smartphone purchases with sustainability requirements when sustainability is highly valued.

Besides the demographic variables of consumers, and psychological variables price sensitivity is also closely involved in smartphone purchasing, Much of the research regards price sensitivity as a direct or indirect antecedent of sustainable customer behavior (Ghali-Zinoubi and Toukabri, 2019), and existing research has mainly focused on the correlation between environmentalism, green consumption, price sensitivity, and environmental concerns (Yue et al., 2020) but no study explores its moderating role on the relationship between purchase intention and sustainable and traditional requirements.

Many smartphone producers have realized that sustainable customer requirements will attract consumers' attention and may affect their purchasing decisions, recent research has focused on the effect of environmental protection awareness on green customer behavior (Cerri et al., 2018). Other research has focused on smartphone consumers' perceived values (Tu et al., 2018). And some research has explored the impact of just traditional requirements of smartphones on sustainable perceived value and purchase intention (Wang and Hsu, 2019). However, there is little to no previous research that explores the relationship between sustainable requirements, traditional requirements, perceived value, and purchase intention, also neglecting the impact of product prices which also exerts influence on consumers' smartphone purchasing decisions. As a result, additional sustainable smartphone purchasing decision studies are needed.

We are still left with the questions of the process by which consumers consider sustainable requirements of the products during their purchase and consumption; how important it is for them to adopt sustainable requirements to product design, and how can we measure and compare the effect of sustainable requirements and the traditional ones on sustainable purchase intention? Accordingly, the aim of this research is to investigate the relationship between sustainable requirements, traditional requirements, and sustainable purchase intention. It takes into account the traditional requirements that affect the product design and compares them with the relevant sustainable requirements and impacts on sustainable purchase intentions, and the sustainable perceived value effect as a mediator and price sensitivity as a moderator, and even more so when they are also concerned about the environment.

Since the research works conducted on the relationship between sustainable customer requirements and purchase intention are limited, sustainable and traditional customer requirements influencers and

their impact on sustainable consumers' purchasing decision need to be explored further. For that one of the most significant distinctions of this work is to bridge the gap in the literature, it incorporates variables like sustainable requirements, traditional requirements, sustainable perceived value, and price sensitivity to the purchase intention model, additionally, this research proposes an advanced sustainable purchase intention model. This model examines the relationship between traditional customer requirements, sustainable customer requirements, and sustainable purchase intention for smartphones, as well as the mediation effect of sustainable perceived value and the moderation effect of price sensitivity. As compared to the previous customer purchasing model, which mainly considers the influence of traditional requirements on the customer purchasing decision.

While this study contributes to the literature on consumers' purchasing intention, also it is to assist businesses in effectively targeting different customers' requirements through segmentation analysis to promote marketing strategies that maximize profits while also satisfying customer needs for products with the least negative environmental impact. Regarding the intricacy and variety of variables that could influence sustainable purchase intentions, smartphones in china were selected for this research as a case study in which excellent representations of fast-changing, mass-market products.

Smartphones were selected for this case study which excellent representation of a fast-changings-market product. While the tech industry's rapid expansion of smartphones has changed and eased customers' lives, their production has created environmental issues and a large amount of e-west. It would be prudent for China to develop varied green specifications. The added cost of relatively environmentally safer products would be passed on to the consumers (Tu et al., 2018).

## 2. Literature review and hypotheses

This section proposes a review of the related literature on sustainable purchasing intention, as well as the hypotheses and their consideration that are used in the research model.

### 2.1. Sustainable purchase intention model and hypotheses development

The intention of a customer to buy a product is classified as a purchase intention. It can also be considered as a customer priority for a particular product while observing consumer purchasing behavior (Chen and Lin, 2019). The intention to purchase a product giving importance and preference to environmental considerations has been referred to as green purchase intention. Chen (2016) is of the opinion that green perceived value has a significant positive influence on sustainable purchase intention and eco-friendly purchasing is one part of sustainable behavior consumption (Chen, 2016).

There has been considerable research exploring the differentiation of different consumer classes and levels when it comes to identifying eco-friendly consumers using market segmentation approaches. Gender, age, education, family size, and income differences, have all been shown to have an essential influence on green consumption behavior in previous studies (Chekima et al., 2016), however, other scholars are of the opinion that analyzing the correlation between demographic variables and sustainable purchasing cannot conclusively prove the correlation (Sreen et al., 2018). Other avenues of research have explored the psychological mechanisms of consumers' sustainable purchasing behavior based on classical interpretations of consumer behavior. To this end, the introduction of new psychological variables like "environmental knowledge," "perceived green value," and "perceived self-identification" was designated for the purpose of expanding upon the theory to encompass, analyze, and predict the effectiveness of green consumption behavior (Zhang et al., 2019; Yue et al., 2020). Furthermore, consumers with lower price sensitivity are more inclined to pay more, according to research by Hsu et al. (2017) price sensitivity was found to be a significant factor affecting purchase intentions (Hsu et al., 2017).

Moreover, the possible influence that price sensitivity and sustainable perceived value (in a Chinese context, specifically) on sustainable requirements, traditional requirements, and sustainable purchase intention has not been thoroughly investigated yet.

Following the purpose of this study. to examine the relationship between traditional customer requirements, sustainable customer requirements, and sustainable purchase intention for smartphones in China. Therefore, this research proposes a developed model based on Several theories and models on sustainable purchase intention: the sustainable customer behavior model that investigates the effect of demographic variables and product price on sustainable customer behavior (Huang et al., 2014; Lara, 2020). And also the theoretical conceptual models from an article titled "Does Sustainable Perceived Value Play a Key Role in the Purchase Intention Driven by Product Aesthetics? Taking smart watch as an Example" examines the impact of traditional requirements on sustainable perceived value and purchase intention (Wang and Hsu, 2019).

### 2.2. Sustainable customer requirements of electronic device design and sustainable purchase intention

Rapid economic growth in developing nations, China, in particular, has led to too much extremist natural resources consumption and accelerated environmental degradation (Li et al., 2019). Sustainable purchasing is seen as behavior that is environmentally responsible by supporting protecting nature and the environment and has stimulated the interest of businesses and consumers recently. Purchasing sustainable products for daily consumption is perceived to be an efficient way to deal with environmental issues (Yue et al., 2020).

Authoritative guidelines for ensuring sustainable growth of the electronics industry undergoing a phase of explosive growth were set by the International Electronics Manufacturing Initiative in 2005 and sought to specify future research, expansion, and functional requirement. Five key areas were to be focused upon: design, energy, recycling, materials, and sustainability (Tu et al., 2018).

Sustainability has been the focus of much academic concern. Paiano et al. (2013) take into consideration how the other users' behavioral types would impact the smartphones, sustainability. Some academics have attention to the sustainability of the smartphone business model and developed a sustainable smartphone business

model by integrating design, modularity in products, and the systems of product and service (Schneider et al., 2018). The rationale behind supporting this approach was to reduce the impact of smartphone production on the environment during the manufacturing phase, during the life cycle of a smartphone, this considers the majority of the emissions.

Changes in consumer requirements as a result of environmental concerns could affect the design and product time to the market. There is consensus in the industry now on obtaining sustainable requirements in the products along with traditional product requirements (Koçak et al., 2015; Alli et al., 2019).

Environmental is an important term in new product development because the whole life cycle of a product takes into account environmental requirements at all phases which would cause the least amount of environmental effect through the product's life cycle, whereas eco-design considers environmental elements and economic elements during all product design phases. Those elements according to the World Business Council for Sustainable Development (WBCSD) include: Reducing the material intensity, reducing the energy intensity, minimizing the emission of toxic materials, increasing recyclability, enhancing sustainable use of renewable resources, improving durability, and increments in service intensity of goods and service (Chen and Liu, 2003), lately the definitions of sustainable design are also incorporating notions such as signifying a better quality of life in the second generation, the elements of the product design have changed to involve economic, social, and environmental elements such as working conditions, health and safety, wages, child labor, gender equity and social benefits such as fair trade and a living wage as well as the environmental influence throughout a product's entire life cycle. The sustainable design then starts involving requirements like reduction of the material usage, ease of capability to process and assemble, transport, reduction of energy usage, low cost, durability, reusability, safe to use, safe level of emissions, capability to store, easy to clean and disassemble (Romli et al., 2015; Alli et al., 2019). These consumer expectations reflect the economic, social, and environmental considerations besides traditional requirements such as speed, resolution, easy disassembly for repair, incorporation of new technologies, reliability, size, weight, shape, ease of use, safe, durability, and large memory (Hsu et al., 2012; Wang and Hsu, 2019).

A total of 23 customer requirements for smartphones were obtained from literature reviews, interviews, and questionnaires. These requirements are further categorized into four categories: performance, easy to use, structure design requirements, and Sustainable.

There is clear supporting evidence that customer requirements for smartphones influence sustainable purchase intention. Considering the preceding arguments, it is expected that both sustainable and traditional requirements have a significant relationship with sustainable purchase intention. Based on the above, this research proposes the following hypotheses:

> *Hypothesis 1*: sustainable requirements have a positive relationship with sustainable purchase intention.
>
> *Hypothesis 2*: traditional requirements have a positive relationship with sustainable purchase intention.
>
> *Hypothesis 2a*: performance requirements have a positive relationship with sustainable purchase intention.
>
> *Hypothesis 2b*: ease of use requirements have a positive relationship with sustainable purchase intention.
>
> *Hypothesis 2c*: structure design requirements have a positive relationship with sustainable purchase intention.

## 2.3. Sustainable perceived value and sustainable purchase intention

During the 1990s, the importance of focusing on customer value has been recognized as a dominant marketing concept. In this research, the concept of sustainable perceived value was associated with green perceived value and ecological perceived value, both of which have been correlated to consumers' environmental attitudes and sustainable purchasing in earlier studies (Chen, 2013). Sustainable Perceived Value is a way for customers to convey their thoughts and ideas, as well as the value displayed by purchasing eco-friendly items. This manner of the propagation of ecological resources seems to be the outcome of a complex construct of cognitive and emotional factors. A number of factors can impact goal-oriented behavior, such as functions, society, and emotional factors (Tu et al., 2018).

Several researchers have indicated that the driving factors behind purchasing behaviors include functional, social, and emotional values (Toufani et al., 2017; Wang and Hsu, 2019). Therefore in this research, the sustainable perceived value was divided into three categories: functional value, social value, and emotional value, as listed below.

Functional value: The term "functional" is related to a product's ability to provide a variety of advantages and features to its users.

Social value: related to how buyers may assume that by purchasing eco-friendly electrical products, they may improve their social position.

Emotional value: related to forming emotional attachments between users and products, and the environment.

Recently, Quade and Leimstoll (2017) propose a method to determine the influence of perceived value on the productive business operations of any company by studying the perceived value of smartphones for small and medium companies (Quade and Leimstoll, 2017).

Accordingly, this study assumes that the impact of customer requirements of smartphones will go through Sustainable perceived value first before it reaches sustainable purchase intention. Hence, this research proposes the following hypotheses:

> *Hypothesis 3*: sustainable perceived value mediates the relationship between sustainable requirements and sustainable purchase intention.
>
> *Hypothesis 4*: sustainable perceived value mediates the relationship between traditional requirements and sustainable purchase intention.
>
> *Hypothesis 4a*: sustainable perceived value mediates the relationship between performance requirements and sustainable purchase intention.

*Hypothesis 4b*: sustainable perceived value mediates the relationship between easy-to-use requirements and sustainable purchase intention.

*Hypothesis 4c*: sustainable perceived value mediates the relationship between structure requirements and sustainable purchase intention.

## 2.4. Price sensitivity and sustainable purchase intention

Price sensitivity is the amount of user responsiveness to price changes as well as price variations between products (Ghali-Zinoubi and Toukabri, 2019). A lot of studies considered price sensitivity as an explicit or implicit predictor of whether or not customers would buy an eco-friendly product (Yue et al., 2020), but there is a dearth of research exploring its impact as a mediator between consumers' consumption requirements and sustainable purchase intentions. Even in a situation where consumers expressed a desire to support eco-friendly products, it might not reflect in their actions as the price of such products with sustainable requirements is usually more than that of products with traditional requirements. Researchers discovered that price sensitivity played an essential role in purchase intentions, and often it would be seen that consumers with low price sensitivity would go for products such as electric cars (Hsu et al., 2017).

Based on data obtained from previous studies, it can thus be asserted that price-sensitive consumers have a lower likelihood of acting upon their environmental concerns which would lead to them having less impact on sustainable purchase intention. Therefore, this leads us to more hypotheses as well:

*Hypothesis 5*: The price moderates the relationship between sustainable requirements and sustainable purchase intention. This relationship is stronger when the price is higher than when it is lower.

*Hypothesis 6*: The price moderates the relationship between traditional requirements and sustainable purchase intention. This relationship is stronger when the price is higher than when it is lower.

## 2.5. The conceptual model

Based on the above in the research literature review, the sustainable requirements and traditional requirements affect product design and have an impact on sustainable purchase intention, while the perceived sustainable value role as mediator and price sensitivity was a moderator. Figure 1 shows the research model.

# 3. Method of analysis and process

The process to measure the relationship between traditional customer requirements, sustainable customer requirements, and sustainable purchase intention for smartphones and to explore whether this relationship is moderated by price, as well as the mediation effect of sustainable perceived value is based on two phases: collecting the data in the first phase, and then analyzing it in the second. Questionnaires and interviews were used for the first phase of the data collection process. In the second phase, the SPSS (Version 23) program was used for the data analysis. The following are the analytical steps:

The first step is factor analysis, to examine the reliability and validity of all research variables, this study used Confirmatory factor analysis (CFA). The validity of the data was examined through the usage of KMO and Bartlett tests to verify sample size sufficiency and Cronbach's α coefficient of the research variables was used to test reliability. Then correlation analysis was applied to examine the correlation between research variables.

Variance analysis in the second step, the T-test (T-test) and One-way ANOVA were applied to examine the score variations between the demographic variables on the research variables (Tu et al., 2018). To see whether there are any variations in scoring between genders and marital status on the research variables a t-test was carried out to determine the results, One-way ANOVA was implemented to examine the score variations between education level, age, and income on the research variables.

The third step tests the hypotheses by (1) analyzing the direct effect. A correlation in SPSS was performed to show the correlations between the research variables and determine the direction and significance of their relationships. Then regression analysis in SPSS (Version 23) was used to test the connection between sustainable requirements and purchase intention then traditional requirements and purchase intention, (2) examine the mediating effect of sustainable perceived value, to investigate if there is a link between sustainable requirements and sustainable purchase intention by sustainable perceived value, we used regression analysis in SPSS (Version 23), then used a Sobel test. The Sobel test is a method to test the significance of the mediation effect, which is basically a customized t-test that detects if the reduction in the independent variable's influence after incorporating the mediator in the model is a significant reduction, and therefore whether the mediation effect is statistically significant (Wang and Hsu, 2019; Lara, 2020; Yue et al., 2020), (3) examine the moderating effect of price sensitivity, the PROCESS macro for SPSS was used to investigate the moderating effects of price sensitivity in this research by using Hayes' moderated mediation method (Lara, 2020; Yue et al., 2020).

## 3.1. Measurement of variables

For the purpose of testing the proposed hypothesis, a qualitative and a quantitative cross-sectional survey design will be undertaken by this research. Due to the study having a cross-sectional design, the priorities and the assessment of the sample of customers on smartphones are gathered at a single point in time. To collect the relevant data, an online survey was carried out. Individuals are the object of analysis in this study.

There are two main components to the questionnaire. The demographic variables, or data collected on respondents' socio-demographic variables, are presented in the first part (gender, age, marital status, educational levels, and monthly income). The second part examines five research variables; technical customer requirements, sustainable customer requirements price sensitivity,

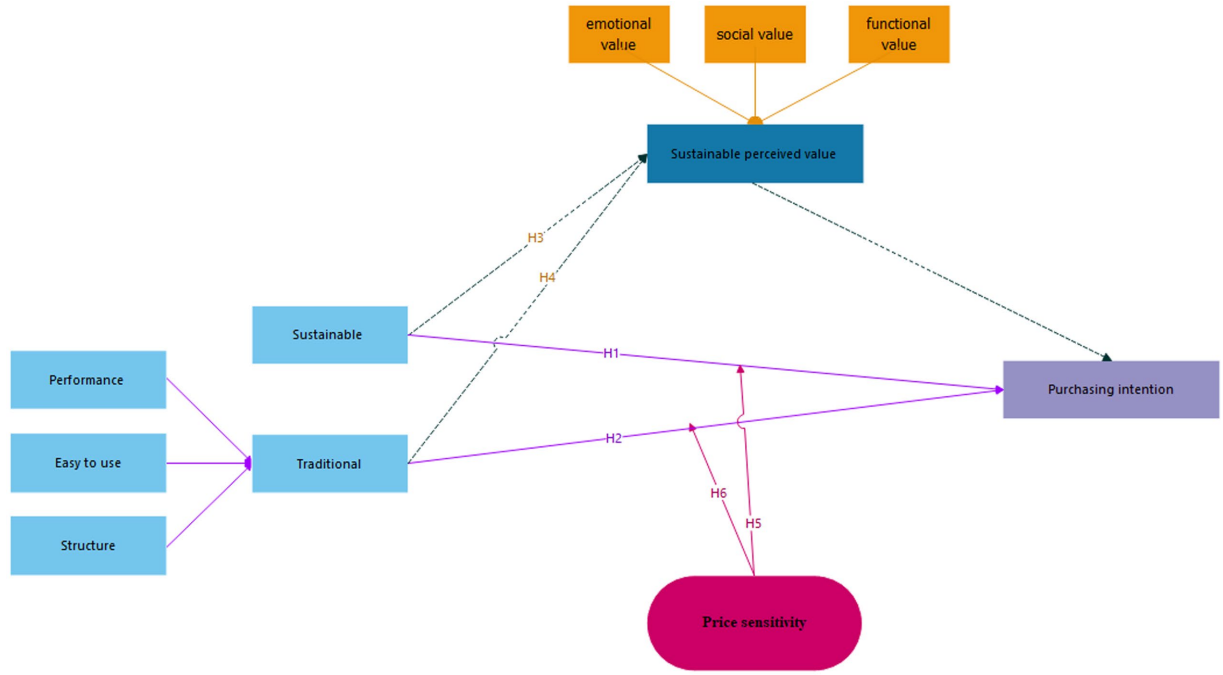


FIGURE 1
Sustainable purchase intention model.

sustainable perceived value, and sustainable purchase intention. With respect to smartphones, the measurement of the questionnaire items in this research is modified from prior studies in order to evaluate the components in this research's suggested research model Responses were recorded using a 5-point Likert scale extending from strongly disagree to strongly agree.

The smartphones customer requirements data was formed based on a review of the literature (Chen and Liu, 2003; Koçak et al., 2015; Alli et al., 2019; Wang and Hsu, 2019), and interviews, are divided into four aspects (sustainable, performance, ease of use, and structure design) and consists of 22 items (see Appendix A for the measurement items). The elements of the sustainable perceived values which are divided into three aspects (functional value, social value, and emotional value) were adapted from Koller et al. (2011) and consist of 6 items (see Appendix A for the measurement items). The measurement of purchase intention was made with two items scale adapted from Dehghani and Kim (2019). And According to Sinha and Batra (1999), a three-item scale was used to measure price sensitivity (see Appendix A for the measurement items).

## 3.2. Data collection and the sample

Consumers were presented with a formed questionnaire through the mini-program online survey platform that was built into the widely used WeChat app. An estimate in 2018 put the active daily users of WeChat at 350 million across China and the world, in this study, the survey was carried out on a sample of people of various ages, education levels, marital statuses, and income levels. In order to ensure an acceptable number of responses an online questionnaire survey has been adopted by using the WeChat app to distribute the questionnaires to various cities in China and just enabling participants who purchased smartphones to be eligible to participate in the survey. We sent 850 questionnaires and 541 were received, out of 541 questionnaires, 379 of the participants were able to qualify for the valid data who correctly completed the survey questions, and made up the representative sample. 379 were adequate for quite a high response rate of 70% during 5 months.

According to Boomsma and Hoogland (2001), researchers required at least 200 participants to apply structural equation modeling, therefore if the sample is more than 200 participants it is quite an efficient sample, therefore this study relatively has high reliability, and fulfills the condition of the sample size of more than 200, to complete the upcoming step of the research procedure.

As you can see in Table 1 the largest percentage of the participants was male 58.6, 54.6% of participants were single, and 41.7% of participants were aged (20–30) years. 44.3% of the participants had a level of education higher than a bachelor's degree. The majority of participants (55.4%) reported their average monthly income to be between (1000–4,000) RMB, and 32.2% of the participants reported their average monthly income was above 6,000.

# 4. Analysis of empirical results

## 4.1. Factor analysis

### 4.1.1. Reliability and validity analysis

This study used Confirmatory factor analysis (CFA) to test the reliability and validity of all research variables. The validity of the data

TABLE 1 Respondent of demographic variables (*N*=379).

| Variables | Classification | Percent |
|---|---|---|
| **Gender** | males | 58.6 |
| | females | 41.4 |
| **Marital status** | singles | 54.6 |
| | married | 45.4 |
| **Educational level** | lower than a bachelor's degree | 12.9 |
| | bachelor's degree | 42.7 |
| | more than a bachelor's degree | 44.3 |
| **Age** | 20–30 | 41.7 |
| | 31–40 | 38.3 |
| | 41–50 | 7.9 |
| | 51and more | 12.1 |
| **Income** | 1,000–2000 | 32.2 |
| | 2000–4,000 | 23.2 |
| | 4,000–6,000 | 12.4 |
| | 6,000 and more | 32.2 |

was examined through the usage of KMO and Bartlett tests to verify sample size sufficiency. The KMO test for the five variables was 90.0%, and the Bartlett test results (were 5136.693, $p < 0.001$); the Bartlett test was also significant like KMO. Thus, it would be correct to conclude that sufficient data were gathered from the questionnaires to make it appropriate for moving forward with Factor Analysis.

Cronbach's α coefficient of all research variables was used to test reliability. Generally, the lowest required value of Cronbach's α coefficient is 0.70. Factor loadings were employed to measure convergent validity. Factor loadings and Alpha values were both greater than 0.5 and more than 0.7, respectively (Hair et al., 2006; Javed et al., 2022). As shown in Table 2 the Cronbach's α coefficient of sustainable customer requirements was 0.807, traditional requirements were 0.811, the sustainable perceived value was 0.721, price sensitivity was 0.768, and purchase intention was 0.734, all of the measurements had a critical value of 0.70, showing that the measurements were reliable.

The first variable value was 28.7%, below 50%. If the correlation coefficient of the comparative variables is more than 0.90, the CMV will be higher. Table 2 shows that the correlation coefficient's maximum value was 0.637, which was significantly below 0.90, and the CMV has been within acceptable limits. As a result, this research's CMV is relatively low.

### 4.1.2. Descriptive statistics and correlation analysis

The means and standard deviations of the five variables are presented in Table 3, whereas Table 4 presents the correlation matrix, which shows the correlations between the research variables. According to correlation analysis, purchase intention was significantly positively correlated. With sustainable requirements ($r = 0.470$, $p < 0.01$), with traditional requirements ($r = 0.366$, $p < 0.01$), and with sustainable perceived value ($r = 0.447$, $p < 0.01$), while significantly negatively correlated with price sensitivity ($r = -0.106$, $p < 0.05$).

## 4.2. Variance analysis

### 4.2.1. One-way ANOVA analysis and *T*-test on the research variables

This research examined the score variations between the five socio-demographic variables (gender, married status, education level, age, and income) on the research variables which are identified in the earlier section. To see whether there are any variations in scoring between genders and marital status on the research variables a *t*-test was carried out to determine the results, One-way ANOVA was implemented to examine the score variations between education level, age, and income on the research variables.

The scores scaled by gender achieved a significant level for sustainable requirements, as shown in Table 5, as judged (value of $p < 0.05$). Males had a higher mean score than females, in favor of males with a mean of 4.346, and reached a significant level for easy-to-use requirements. Males had a higher mean score than females, in favor of males with a mean of 4.223. Regarding the other factors, the scores did not reach significance levels (value of $p > 0.05$), thus gender variations did not reveal significantly different perceived values for research variables.

With respect to the influence of marital status, the scores scaled by marital status achieved a significant level for performance requirements as judged (value of $p < 0.05$). Singles had a higher mean score than married, in favor of singles with a mean of 4.487, and reached a significance level for easy-to-use requirements as judged (value of $p < 0.05$). Married had a higher mean score than singles, in favor of males with a mean of 4.227. Regarding the research variables, the scores of all of the research variables did not reach significance levels (value of $p > 0.05$), As a result, there were no significant differences in perceived values for the research variables across respondents of various marital statuses (Table 6).

In regards to respondent scores at different levels of education (lower than bachelor's degree, bachelor's degree, higher than bachelor's degree), the scores sorted by education levels for easy-to-use requirements did not reach a significant level as judged (value of $p > 0.05$), while reaching significance levels for all other research variables (value of $p < 0.05$).

Table 7 shows the differences between education levels on sustainable requirements, respondents with education levels higher than bachelor's ($M = 4.55$) had much more positive attention to sustainable requirements than respondents with other education levels. Respondent scores among different education levels related to traditional requirements compared with those with bachelor's degrees and higher did not reach significance levels (value of $p > 0.05$), while the other categories did reach significance levels (value of $p < 0.05$) in favor of those with a higher level of education ($M = 4.35$). With respect to the scores of respondents with different education levels on sustainable perceived value for bachelor's degree and higher did not reach significance levels (value of $p > 0.05$), while the other categories did reach significance levels (value of $p < 0.05$) in favor of higher than bachelor's ($M = 4.06$). Scores of respondents with different education levels on the price sensitivity value for bachelor's degree and higher did not reach significance levels (value

TABLE 2 Reliability and validity analysis of the research variables.

| Variables | Factor loading | Cronbach's α | CR | AVE | ✓ AVE |
|---|---|---|---|---|---|
| 1. Sustainable requirements | 0.591 | 0.807 | 0.926 | 0.464 | 0.681 |
| | 0.639 | | | | |
| | 0.671 | | | | |
| | 0.831 | | | | |
| | 0.578 | | | | |
| | 0.751 | | | | |
| | 0.570 | | | | |
| | 0.683 | | | | |
| | 0.768 | | | | |
| 2. Traditional requirements | | 0.811 | 0.958 | 0.516 | 0.718 |
| 2.1 Performance requirements | 0.739 | 0.812 | 0.933 | 0.527 | 0.726 |
| | 0.448 | | | | |
| | 0.796 | | | | |
| | 0.782 | | | | |
| | 0.615 | | | | |
| | 0.751 | | | | |
| | 0.651 | | | | |
| | 0.730 | | | | |
| 2.2 Ease of use requirements | 0.710 | 0.784 | 0.832 | 0.584 | 0.764 |
| | 0.739 | | | | |
| 2.3 Design requirements | 0.799 | 0.760 | 0.797 | 0.516 | 0.718 |
| | 0.773 | | | | |
| | 0.734 | | | | |
| 3. Perceived sustainable value | | 0.821 | 0.873 | 0.431 | 0.657 |
| 3.1 Functional value | 0.552 | 0.756 | 0.872 | 0.652 | 0.807 |
| | 0.684 | | | | |
| 3.2 Social value | 0.500 | 0.779 | 0.874 | 0.658 | 0.811 |
| | 0.790 | | | | |
| 3.3 Emotional value | 0.640 | 0.793 | 0.902 | 0.714 | 0.845 |
| | 0.790 | | | | |
| 4. Price sensitivity | 0.855 | 0.768 | 0.879 | 0.601 | 0.775 |
| | 0.875 | | | | |
| | 0.555 | | | | |
| 5. Purchase intention | 0.827 | 0.734 | 0.887 | 0.684 | 0.827 |
| | | | 0.827 | | |

CMV = 28.7%, KMO and Bartlett's Test = 90.0%, Bartlett's Test (5136.693, $P < 0.001$).

TABLE 3 Descriptive statistics.

| Variables | Mean | Std. deviation |
|---|---|---|
| 1. Sustainable requirements | 4.283 | 0.740 |
| 2. Traditional requirements | 4.196 | 0.676 |
| 2.1 Performance requirements | 4.354 | 0.761 |
| 2.2 Easy-to-use requirements | 4.075 | 1.007 |
| 2.3 Structure requirements | 4.160 | 0.895 |
| 3. Sustainable perceived value | 3.874 | 0.928 |
| 3.1 Functional value | 4.346 | 0.949 |
| 3.2 Social value | 3.471 | 1.304 |
| 3.3 Emotional value | 3.806 | 1.252 |
| 4. Price sensitivity | 3.651 | 1.205 |
| 5. Purchase intention | 3.708 | 1.191 |

of $p > 0.05$) while reaching significance levels (value of $p < 0.05$) for other categories in favor of lower than bachelor's (M = 4.51); and the scores of respondents with different education levels on purchase intention for bachelor's degree and higher than bachelor did not reach significance levels (value of $p > 0.05$) with other categories reaching significance levels (value of $p < 0.05$), in favor of higher than bachelor's (M = 4.00).

As for respondents with different ages (20–30, 31–40, 41–50, and 51and more), the scores sorted by age for easy-to-use requirements did not reach a significance level, as judged (value of $p > 0.05$). While reaching significant levels for all other research variables (value of $p < 0.05$).

Table 8 shows that there are differences between the ages of sustainable requirements respondents for all categories (group) with (51 and more), in favor of other categories. There are differences between ages on traditional requirements respondents for all categories with (51 and more), in favor of other categories. Regarding the differences of respondents with ages on sustainable perceived value respondents for all categories with (51 and more), were in favor of other categories. There are differences between the ages of price sensitivity value respondents for all categories with (51 and more), in favor of (51 and more; M = 4.63), also for (20–30) with (41–50) in favor of (20–30; M = 3.70), and for (31–40) with (41–50) in favor of (31–40; M = 3.52). Finally, there are differences between the ages of purchase respondents for all categories (51 and more), in favor of other categories.

As for respondents with different incomes (1000–2000, 2000–4,000, 4,000–6,000, and 6,000 and more), they reached a significance level for sustainable requirements, performance requirements, structure requirements, sustainable perceived value, and price sensitivity, as judged (value of $p < 0.05$). The rest of the research variables did not reach significance levels (value of $p > 0.05$), As a result, there were no significant differences in perceived values for the rest of the research variables across responders of different income levels. Table 9 shows that there are different income on sustainable requirements for respondents (1000–2000) RMB with (4000–6,000) RMB, and also for (2000–4,000) RMB with (4000–6,000) RMB, in favor of (4000–6,000) RMB for both (M = 4.65). Regarding the differences of respondents with income on sustainable perceived value for (1000–2000) RMB with (4000–6,000) RMB, and also for

TABLE 4 Correlation analysis.

| Variables | 1 | 2 | 2.1 | 2.2 | 2.3 | 3 | 3.1 | 3.2 | 3.3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 1 | | | | | | | | | | |
| 2. | 0.773** | 1 | | | | | | | | | |
| 2.1. | 0.222** | 0.363** | 1 | | | | | | | | |
| 2.2. | 0.730** | 0.664** | 0.108* | 1 | | | | | | | |
| 2.3. | 0.637** | 0.870** | 0.697** | 0.722** | 1 | | | | | | |
| 3. | 0.517** | 0.511** | 0.357** | 0.563** | 0.614** | 1 | | | | | |
| 3.1. | 0.246** | 0.369** | 0.124* | 0.365** | 0.361** | 0.368** | 1 | | | | |
| 3.2. | 0.431** | 0.409** | 0.147** | 0.566** | 0.465** | 0.477** | 0.472** | 1 | | | |
| 3.3. | 0.485** | 0.531** | 0.246** | 0.617** | 0.587** | 0.727** | 0.806** | 0.833** | 1 | | |
| 4. | −0.365** | −0.064 | 0.177** | −0.215** | −0.021 | −0.132* | 0.172** | −0.057 | 0.010 | 1 | |
| 5. | 0.470** | 0.366** | 0.117* | 0.494** | 0.405** | 0.447** | 0.315** | 0.424** | 0.491** | −0.106* | 1 |

*Correlation was significant at $p < 0.05$ (2-tailed).
**Correlation was significant at $p < 0.01$ (2-tailed).

TABLE 5 *T*-test of gender on research variables.

| Variables | Gender | No. | Mean | S.D. | *t* value | *P* value |
|---|---|---|---|---|---|---|
| 1. | Males | 222 | 4.346 | 0.762 | 1.976 | **0.049** |
| | Females | 157 | 4.194 | 0.700 | | |
| 2. | Males | 222 | 4.224 | 0.722 | 0.934 | 0.351 |
| | Females | 157 | 4.158 | 0.606 | | |
| 2.1. | Males | 222 | 4.315 | 0.794 | −1.201 | 0.230 |
| | Females | 157 | 4.410 | 0.710 | | |
| 2.2. | Males | 222 | 4.223 | 1.018 | 3.447 | **0.001** |
| | Females | 157 | 3.866 | 0.955 | | |
| 2.3. | Males | 222 | 4.134 | 0.945 | −0.684 | 0.495 |
| | Females | 157 | 4.197 | 0.819 | | |
| 3. | Males | 222 | 3.841 | 0.998 | −0.832 | 0.406 |
| | Females | 157 | 3.921 | 0.820 | | |
| 3.1. | Males | 222 | 4.349 | 0.948 | 0.084 | 0.933 |
| | Females | 157 | 4.341 | 0.954 | | |
| 3.2. | Males | 222 | 3.466 | 1.404 | −0.084 | 0.933 |
| | Females | 157 | 3.478 | 1.154 | | |
| 3.3. | Males | 222 | 3.707 | 1.369 | −1.834 | 0.067 |
| | Females | 157 | 3.946 | 1.054 | | |
| 4. | Males | 222 | 3.712 | 1.235 | 1.170 | 0.243 |
| | Females | 157 | 3.565 | 1.160 | | |
| 5. | Males | 222 | 3.662 | 1.278 | −0.899 | 0.369 |
| | Females | 157 | 3.774 | 1.057 | | |

(2000–4,000) RMB with (4000–6,000) RMB, in favor of (4000–6,000) RMB for both (M = 4.34). The differences of respondents with income on price sensitivity value (1000–2000) RMB with (4000–6,000) RMB in favor of (1000–2000) RMB (M = 3.77), also for (2000–4,000) RMB with (4000–6,000) RMB in favor of (2000–4,000) RMB for both (M = 4.09), and (2000–4,000) RMB with (6,000 and more) RMB, in favor of (2000–4,000) \ for both (M = 4.09).

## 4.3. Hypotheses testing

### 4.3.1. Analyzing the direct effect

Regression analysis in SPSS (Version 23) was used to test the connection between sustainable requirements and purchase intention. Table 10 presents the findings of this research's main effect analysis. $H_1$ expected that sustainable requirements have a positive relationship with sustainable purchase intention, which is supported ($\beta = 0.756$, value of $p < 0.001$). In addition, traditional requirements have a positive relationship with sustainable purchase intention, which is supported by $H_2$ ($\beta = 0.713$, value of $p < 0.001$). $H_{2a}$ predicted that performance requirements would have a positive relationship with sustainable purchase intention, which is supported ($\beta = 0.488$, value of $p < 0.001$), and $H_{2b}$ also predicted that ease of use requirements would have a positive relationship with the sustainable purchase intention, which is supported ($\beta = 0.138$, value of $p < 0.05$), and design requirements were hypothesized to have a positive relationship with sustainable purchase intention, which is supported with $H_{2c}$ ($\beta = 0.773$, value of $p < 0.001$).

### 4.3.2. Analysis of the mediating effect of sustainable perceived value

To investigate if there is a link between sustainable requirements and sustainable purchase intention by sustainable perceived value, we used regression analysis in SPSS (Version 23), then used a Sobel test. The Sobel test is a method to test the significance of the mediation effect, which is basically a customized *t*-test that detects if the reduction in the independent variable's influence after incorporating the mediator in the model is a significant reduction, and therefore whether the mediation effect is statistically significant.

Table 11 shows the expected indirect effect of sustainable requirements on sustainable perceived value, which is supported ($\beta = 0.608$, S.E. = 0.056), and the direct effect of sustainable perceived value on purchase intention ($\beta = 0.630$, S.E. = 0.058), then followed by application of the Sobel test which is supported with $H_3$ (S.E. = 0.049, value of $p < 0.001$), thus highlighting how sustainable perceived value mediates the relationship between sustainable requirements and sustainable purchase intention.

TABLE 6 T-test of marital status on research variables.

| Variables | Marital status | No. | Mean | S.D. | *t* value | *P* value |
|---|---|---|---|---|---|---|
| 1. | Singles | 207 | 4.303 | 0.656 | 0.603 | 0.547 |
| | Married | 172 | 4.258 | 0.832 | | |
| 2. | Singles | 207 | 4.225 | 0.690 | 0.892 | 0.373 |
| | Married | 172 | 4.163 | 0.659 | | |
| 2.1. | Singles | 207 | 4.487 | 0.632 | 3.783 | **0.000** |
| | Married | 172 | 4.195 | 0.867 | | |
| 2.2. | Singles | 207 | 3.949 | 1.048 | −2.693 | **0.007** |
| | Married | 172 | 4.227 | 0.936 | | |
| 2.3. | Singles | 207 | 4.238 | 0.854 | 1.874 | 0.062 |
| | Married | 172 | 4.066 | 0.935 | | |
| 3. | Singles | 207 | 3.892 | 0.901 | 0.411 | 0.681 |
| | Married | 172 | 3.853 | 0.962 | | |
| 3.1. | Singles | 207 | 4.355 | 0.965 | 0.212 | 0.832 |
| | Married | 172 | 4.334 | 0.934 | | |
| 3.2. | Singles | 207 | 3.531 | 1.273 | 0.989 | 0.323 |
| | Married | 172 | 3.398 | 1.341 | | |
| 3.3. | Singles | 207 | 3.79 | 1.239 | −0.276 | 0.783 |
| | Married | 172 | 3.826 | 1.271 | | |
| 4. | Singles | 207 | 3.733 | 1.053 | 1.453 | 0.147 |
| | Married | 172 | 3.552 | 1.362 | | |
| 5. | Singles | 207 | 3.812 | 1.068 | 1.855 | 0.064 |
| | Married | 172 | 3.584 | 1.317 | | |

In addition, sustainable perceived value mediates the relationship between traditional requirements and sustainable purchase intention which is supported by $H_4$ (S.E. = 0.059, value of $p < 0.001$). $H_{4a}$ predicted that sustainable perceived value mediates the relationship between performance requirements and sustainable purchase intention, which is supported (S.E. = 0.053, value of $p < 0.001$). $H_{4b}$ predicted that sustainable perceived value mediates the relationship between easy-to-use requirements and sustainable purchase intention, which is supported (S.E. = 0.031, value of $p < 0.001$), and $H_{4c}$ predicted that sustainable perceived value mediates the relationship between design requirements and sustainable purchase intention, which is supported (S.E. = 0.043, value of $p < 0.001$).

### 4.3.3. Analysis of the moderating effect of price sensitivity

The PROCESS macro for SPSS was used to investigate the moderating effects of pricing by using Hayes' moderated mediation method. Table 12 shows the results of the moderating effects of price sensitivity in this research. Sustainable requirements and price sensitivity interaction indicated that H5 is not supported since the moderating effects of price sensitivity between sustainable requirements and purchase intention were not significant [*p*-value (Interaction1) < 0.001, while value of *p* (Price) > 0.05].

However, traditional requirements and price sensitivity interaction indicated that H6 is supported since the price sensitivity moderates the relationship between traditional requirements and purchase intention and influences the negative impact of traditional requirements on purchase intention [value of *p* (Interaction2) < 0.001, while value of *p* (Price) < 0.0].

## 5. Discussion

This research examines the impact of sustainable customer requirements on the Purchase Intention of Smartphones in China as well as the traditional requirements. Given that China has the most smartphone users in the world, this is a crucial area to concentrate on (Gartner, 2021). Additionally, due to shorter product cycles, phones get replaced consistently, and discarded smartphones become hazardous e-waste, contributing to environmental degradation as well as detrimental to human health. Based on the research hypotheses (H1) expected that sustainable requirements have a positive relationship with sustainable purchase intention. And (H2) traditional requirements have a positive relationship with sustainable purchase intention. Results revealed that Sustainable requirements showed a strong positive correlation with purchase intention, and were the strongest among all the other variables, especially against traditional requirements which were relatively weaker, this observation is consistent with the previous research (Wang and Hsu, 2019; Kempen and Betzler, 2021) and among traditional requirements of smartphones, the performance aspect held greater significance than easy-to-use and structure requirements. However, price played an important role in the purchase decision and has an impact on consumer requirements of smartphones. At the same time, this research examined the score variations between the five socio-demographic factors (gender, married status, education level, age, and income) on the research variables and the findings revealed that males with more than a bachelor's degree, aged between 41 to 50, and earning a monthly income between 4,001 to 6,000 RMB had a significant influence on the sustainable requirements of smartphones. This result indicated that males with high education levels and aged between 41 to 50 were more knowledgeable and more concerned over environmental issues and sustainable design and had a correspondingly high income making them less sensitive toward prices, showing higher purchase intention toward sustainable smartphones such as recyclability, energy saving, no toxic material released, less waste, lower environmental impact, safe, information and data security, durability, and easy maintenance, even if those features made the products expensive. Based on previous research, females exhibited a higher level of environmental consciousness than males and a willingness to pay more for sustainable designs (Laroche et al., 2001; Tu et al., 2018). In this research, males had a significant influence on the sustainable requirements of smartphones, which may be related to the sample size, and the majority of the responders were males. Because gender influences sustainable requirements, smartphone manufacturers can design suitable strategies to satisfy target customer preferences.

Gender did not significantly affect traditional requirements and those aged between 20 to 30 had a significant influence on traditional requirements of smartphones. The results in this category indicated that young customers seemed to be less concerned about the environment and sustainable design and more into traditional requirements such as the reliability of smartphones, large memory, and high-resolution screens which they preferred over easy-to-access, shape, and size requirements to suit their needs more. And since they have a monthly income ranging between 2000

TABLE 7 One-way ANOVA of education on research variables.

| Variables | Education | No. | Mean | S.D. | f value | *P* value |
|---|---|---|---|---|---|---|
| 1. | 1. lower than bachelor's | 49 | 3.175 | 0.688 | 102.29 | **0.000** |
| | 2. bachelor's degree | 162 | 4.337 | 0.613 | | |
| | 3.more than bachelor's | 168 | 4.554 | 0.552 | | |
| 2. | 1. lower than bachelor's | 49 | 3.571 | 0.649 | 29.09 | **0.000** |
| | 2.bachelor's degree | 162 | 4.229 | 0.654 | | |
| | 3.more than bachelor's | 168 | 4.347 | 0.603 | | |
| 2.1. | 1. lower than bachelor's | 49 | 3.270 | 0.963 | 82.939 | **0.000** |
| | 2.bachelor's degree | 162 | 4.461 | 0.620 | | |
| | 3.more than bachelor's | 168 | 4.567 | 0.523 | | |
| 2.2. | 1. lower than bachelor's | 49 | 4.061 | 1.093 | 1.643 | 0.195 |
| | 2. bachelor's degree | 162 | 3.975 | 1.006 | | |
| | 3.more than bachelor's | 168 | 4.176 | 0.978 | | |
| 2.3. | 1. lower than bachelor's | 49 | 3.381 | 0.861 | 24.086 | **0.000** |
| | 2. bachelor's degree | 162 | 4.251 | 0.847 | | |
| | 3. more than bachelor's | 168 | 4.300 | 0.837 | | |
| 3. | 1. lower than bachelor's | 49 | 3.060 | 0.860 | 25.05 | **0.000** |
| | 2. bachelor's degree | 162 | 3.930 | 0.880 | | |
| | 3. more than bachelor's | 168 | 4.060 | 0.880 | | |
| 3.1. | 1. lower than bachelor's | 49 | 3.582 | 1.165 | 20.781 | **0.000** |
| | 2. bachelor's degree | 162 | 4.401 | 0.874 | | |
| | 3. more than bachelor's | 168 | 4.515 | 0.843 | | |
| 3.2. | 1. lower than bachelor's | 49 | 2.949 | 0.964 | 4.598 | **0.011** |
| | 2. bachelor's degree | 162 | 3.540 | 1.272 | | |
| | 3. more than bachelor's | 168 | 3.557 | 1.390 | | |
| 3.3. | 1. lower than bachelor's | 49 | 2.663 | 1.092 | 28.982 | **0.000** |
| | 2. bachelor's degree | 162 | 3.843 | 1.238 | | |
| | 3. more than bachelor's | 168 | 4.104 | 1.120 | | |
| 4. | 1. lower than bachelor's | 49 | 4.510 | 0.860 | 15.98 | **0.000** |
| | 2. bachelor's degree | 162 | 3.570 | 1.200 | | |
| | 3. more than bachelor's | 168 | 3.460 | 1.200 | | |
| 5. | 1. lower than bachelor's | 49 | 2.520 | 0.880 | 34.88 | **0.000** |
| | 2. bachelor's degree | 162 | 3.770 | 1.190 | | |
| | 3. more than bachelor's | 168 | 4.000 | 1.060 | | |

to 4,000 RMB, the price of products is given a lot of importance by them making them more sensitive to the prices of smartphones. This result might be explained by the fact that young who has low-income respondents deliberate the most when expending a restricted amount of funds.

Regarding H3, H4, and (H4a H4b H4c H4d) the results showed that all sustainable perceived value factors (social value, functional and emotional value) have a positive effect on purchase intention and mediate the relationship between sustainable requirements and purchase intention, and between traditional requirements and purchase intention.

Performance is a basic requirement of customers of smartphones, especially young customers who are more into traditional requirements which enhance the functional value for them when they make their purchasing decisions. Toufani et al. (2017) on the other hand suggest that social value influences purchase intention the most, while functional value has almost no impact. When consumers buy smartphones with sustainable requirements, they present their concern toward environmental protection, and people with greater social positions have more solid motivations at the same time they care to show their society how they are involved with protecting the environment and the planet. And consumers sometimes want to show their social level or their living standard because expensive or latest smartphones can be used to signify status. At the same time, the functional value affects their purchasing decisions too so they prefer the quality and requirements such as reliability, big memory, high resolution, and easy-to-access for the customers who try to keep updated with the latest technology.

TABLE 8 One-way ANOVA of age on research variables.

| Variables | age | No. | Mean | S.D. | f value | *P* value |
|---|---|---|---|---|---|---|
| 1. | 20–30 | 158 | 4.32 | 0.65 | 48.634 | **0.000** |
| | 31–40 | 145 | 4.50 | 0.58 | | |
| | 41–50 | 30 | 4.58 | 0.37 | | |
| | 51 and above | 46 | 3.26 | 0.83 | | |
| 2. | 20–30 | 158 | 4.32 | 0.64 | 17.507 | **0.000** |
| | 31–40 | 145 | 4.27 | 0.64 | | |
| | 41–50 | 30 | 4.19 | 0.48 | | |
| | 51 and above | 46 | 3.57 | 0.71 | | |
| 2.1. | 20–30 | 158 | 4.550 | 0.615 | 86.758 | **0.000** |
| | 31–40 | 145 | 4.513 | 0.498 | | |
| | 41–50 | 30 | 4.563 | 0.293 | | |
| | 51 and above | 46 | 3.046 | 0.838 | | |
| 2.2. | 20–30 | 158 | 4.089 | 0.991 | 2.057 | 0.106 |
| | 31–40 | 145 | 4.048 | 0.981 | | |
| | 41–50 | 30 | 3.750 | 0.917 | | |
| | 51 and above | 46 | 4.326 | 1.151 | | |
| 2.3. | 20–30 | 158 | 4.308 | 0.863 | 17.286 | **0.000** |
| | 31–40 | 145 | 4.241 | 0.866 | | |
| | 41–50 | 30 | 4.267 | 0.528 | | |
| | 51 and above | 46 | 3.326 | 0.853 | | |
| 3. | 20–30 | 158 | 3.99 | 0.87 | 17.473 | **0.000** |
| | 31–40 | 145 | 3.95 | 0.90 | | |
| | 41–50 | 30 | 4.20 | 0.76 | | |
| | 51 and above | 46 | 3.02 | 0.87 | | |
| 3.1. | 20–30 | 158 | 4.453 | 0.817 | 13.251 | **0.000** |
| | 31–40 | 145 | 4.424 | 0.914 | | |
| | 41–50 | 30 | 4.600 | 0.532 | | |
| | 51 and above | 46 | 3.565 | 1.289 | | |
| 3.2. | 20–30 | 158 | 3.573 | 1.311 | 4.667 | **0.003** |
| | 31–40 | 145 | 3.497 | 1.361 | | |
| | 41–50 | 30 | 3.783 | 1.343 | | |
| | 51 and above | 46 | 2.837 | 0.830 | | |
| 3.3. | 20–30 | 158 | 3.956 | 1.219 | 17.254 | **0.000** |
| | 31–40 | 145 | 3.924 | 1.217 | | |
| | 41–50 | 30 | 4.217 | 0.907 | | |
| | 51 and above | 46 | 2.652 | 1.059 | | |
| 4. | 20–30 | 158 | 3.70 | 1.01 | 23.189 | **0.000** |
| | 31–40 | 145 | 3.52 | 1.20 | | |
| | 41–50 | 30 | 2.51 | 1.33 | | |
| | 51 and above | 46 | 4.63 | 0.97 | | |
| 5. | 20–30 | 158 | 3.90 | 1.01 | 24.205 | **0.000** |
| | 31–40 | 145 | 3.79 | 1.28 | | |
| | 41–50 | 30 | 4.23 | 0.75 | | |
| | 51 and above | 46 | 2.46 | 0.92 | | |

TABLE 9 One-way ANOVA of income on research variables.

| Variables | Income | No. | Mean | S.D. | f value | *P* value |
|---|---|---|---|---|---|---|
| 1. | 1,000–2000 | 122 | 4.19 | 0.67 | 5.911 | **0.001** |
| | 2000–4,000 | 88 | 4.14 | 0.81 | | |
| | 4,000–6,000 | 47 | 4.65 | 0.52 | | |
| | 6,000 and more | 122 | 4.33 | 0.78 | | |
| 2. | 1,000–2000 | 122 | 4.26 | 0.65 | 2.637 | 0.050 |
| | 2000–4,000 | 88 | 4.04 | 0.72 | | |
| | 4,000–6,000 | 47 | 4.35 | 0.72 | | |
| | 6,000 and more | 122 | 4.19 | 0.64 | | |
| 2.1. | 1,000–2000 | 122 | 4.452 | 0.697 | 6.225 | **0.000** |
| | 2000–4,000 | 88 | 4.246 | 0.761 | | |
| | 4,000–6,000 | 47 | 4.694 | 0.505 | | |
| | 6,000 and more | 122 | 4.204 | 0.851 | | |
| 2.2. | 1,000–2000 | 122 | 4.016 | 0.960 | 2.065 | 0.104 |
| | 2000–4,000 | 88 | 3.972 | 1.118 | | |
| | 4,000–6,000 | 47 | 3.947 | 1.134 | | |
| | 6,000 and more | 122 | 4.258 | 0.898 | | |
| 2.3. | 1,000–2000 | 122 | 4.303 | 0.875 | 4.709 | **0.003** |
| | 2000–4,000 | 88 | 3.917 | 0.863 | | |
| | 4,000–6,000 | 47 | 4.404 | 0.828 | | |
| | 6,000 and more | 122 | 4.098 | 0.921 | | |
| 3. | 1,000–2000 | 122 | 3.86 | 0.90 | 6.783 | **0.000** |
| | 2000–4,000 | 88 | 3.61 | 0.97 | | |
| | 4,000–6,000 | 47 | 4.34 | 0.70 | | |
| | 6,000 and more | 122 | 3.90 | 0.94 | | |
| 3.1. | 1,000–2000 | 122 | 4.340 | 0.963 | 5.781 | **0.001** |
| | 2000–4,000 | 88 | 4.028 | 1.084 | | |
| | 4,000–6,000 | 47 | 4.660 | 0.685 | | |
| | 6,000 and more | 122 | 4.459 | 0.861 | | |
| 3.2. | 1,000–2000 | 122 | 3.488 | 1.294 | 2.178 | 0.090 |
| | 2000–4,000 | 88 | 3.295 | 1.281 | | |
| | 4,000–6,000 | 47 | 3.883 | 1.336 | | |
| | 6,000 and more | 122 | 3.422 | 1.300 | | |
| 3.3. | 1,000–2000 | 122 | 3.738 | 1.252 | 6.864 | **0.000** |
| | 2000–4,000 | 88 | 3.500 | 1.309 | | |
| | 4,000–6,000 | 47 | 4.489 | 0.741 | | |
| | 6,000 and more | 122 | 3.832 | 1.279 | | |
| 4. | 1,000–2000 | 122 | 3.77 | 0.94 | 9.625 | **0.000** |
| | 2000–4,000 | 88 | 4.09 | 0.91 | | |
| | 4,000–6,000 | 47 | 3.09 | 1.37 | | |
| | 6,000 and more | 122 | 3.43 | 1.42 | | |
| 5. | 1,000–2000 | 122 | 3.65 | 1.11 | 2.494 | 0.060 |
| | 2000–4,000 | 88 | 3.78 | 1.17 | | |
| | 4,000–6,000 | 47 | 4.10 | 1.00 | | |
| | 6,000 and more | 122 | 3.57 | 1.32 | | |

TABLE 10 The results of the direct effect analysis.

| Hypothesis | The effect | Path coefficient | S.E. | *t* value | *P* value | Results |
|---|---|---|---|---|---|---|
| $H_1$ | + | 0.756 | 0.318 | 1.475 | 0.000** | $H_1$ is supported |
| $H_2$ | + | 0.713 | 0.083 | 8.595 | 0.000** | $H_2$ is supported |
| $H_{2a}$ | + | 0.488 | 0.064 | 7.640 | 0.000** | $H_{2a}$ is supported |
| $H_{2b}$ | + | 0.138 | 0.061 | 2.288 | 0.023* | $H_{2b}$ is supported |
| $H_{2c}$ | + | 0.773 | 0.070 | 11.033 | 0.000** | $H_{2c}$ is supported |

*Significant at the $p < 0.05$ (2-tailed).
**Significant at the $p < 0.01$ (2-tailed).

TABLE 11 The regression results of the mediation analysis.

| Hypothesis | Path | Effects | Path coefficient | S.E. | *t* value | *P* value | Results |
|---|---|---|---|---|---|---|---|
| $H_3$ | SR-SPV-PI | Indirect Effect | 0.608 | 0.056 | 10.772 | 0.000 | $H_3$ is supported |
| | | Direct Effect | 0.630 | 0.058 | 10.932 | 0.000 | |
| | | Total Effect | | 0.049 | 7.679 | 0.000 | |
| $H_4$ | TR-SPV-PI | Indirect Effect | 0.806 | 0.057 | 14.091 | 0.000 | $H_4$ is supported |
| | | Direct Effect | 0.630 | 0.058 | 10.932 | 0.000 | |
| | | Total Effect | | 0.059 | 8.614 | 0.000 | |
| $H_{4a}$ | PR-SPV-PI | Indirect Effect | 0.753 | 0.049 | 15.228 | 0.000 | $H_{4a}$ is supported |
| | | Direct Effect | 0.630 | 0.058 | 10.932 | 0.000 | |
| | | Total Effect | | 0.053 | 8.870 | 0.000 | |
| $H_{4b}$ | US-SPV-PI | Indirect Effect | 0.226 | 0.046 | 4.919 | 0.000 | $H_{4b}$ is supported |
| | | Direct Effect | 0.630 | 0.058 | 10.932 | 0.000 | |
| | | Total Effect | | 0.031 | 4.476 | 0.000 | |
| $H_{4c}$ | STR-SPV-PI | Indirect Effect | 0.551 | 0.045 | 12.167 | 0.000 | $H_{4c}$ is supported |
| | | Direct Effect | 0.630 | 0.058 | 10.932 | 0000 | |
| | | Total Effect | | 0.043 | 8.125 | 0.000 | |

Sustainable requirements (SR), purchase intention (PI), sustainable perceived value (SPV), traditional requirements (TR), performance requirements (PR), easy-to-use requirements (US), and structure requirements (STR).

Many researches indicated that emotional value has a significant influence on smartphone purchase intention (Toufani et al., 2017; Wang and Hsu, 2019). According to Chapman (2012), sustainability concerns may be handled by focusing on the product's design lifecycle and linking it to people's emotional needs. Consumers seeking to buy smartphones at the beginning might be attracted to the structure, but what is more important when they make the final purchasing decision is the value they get from the smartphone, this research examined the effect of sustained perceived value as a mediator in increasing purchase intention.

Smartphone producers currently are not playing any role in protecting the environment now have to consider the sustainable design and expand product lifetime by obtaining a design method focused on the product lifecycle. Since the durability of the product influences emotional value, it has a positive effect on purchase intention. To enhance sustainable design, designers should focus on increasing the lifespan of the product. Hsiao and Chen (2018) presented a comprehensive approach to enhancing sustainable design relationships by focusing on consumer requirements, values, and emotions.

In the relationship between traditional requirements and purchase intention, price sensitivity plays a negative moderator. That is, customers with low price sensitivity are more willing to buy smartphones than customers with high price sensitivity. On the other hand, the positive relationship between sustainable requirements and purchase intention is not moderated by price sensitivity, and H5 is not supported. This research proposes, backed by empirical data, that consumers who purchase sustainable design do not have price sensitivity, and display a willingness to acquire smartphones with sustainable requirements even if they are more expensive than competing products. They are influenced by environmental consciousness, which leads to sustainable purchase intention. The findings are consistent with numerous prior studies that have shown that price sensitivity has a negative impact (Stall-Meadows and Davey, 2013; Yue et al., 2020). For that manufacturers should shift customers' attention and consideration toward the price of smartphones with sustainable requirements by highlighting the importance and value of sustainable design requirements.

## 6. Conclusion

The purpose of this research was to investigate the relationship between sustainable requirements, traditional requirements, and purchase intention, and how this relationship was mediated by

TABLE 12 The regression results of the moderation analysis.

| Hypothesis | Model | Coefficient β's | S.E. | *t* Value | *P* value | 95% confidence interval for β | | Results |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Upper | Lower | |
| $H_5$ | Constant | 1.108 | 0.404 | 2.739 | 0.006 | 0.869 | 3.229 | $H_5$ is not supported |
| | SR | 0.627 | 0.087 | 7.217 | 0.000 | 0.147 | 0.667 | |
| | Price | −0.034 | 0.116 | −0.296 | 0.767 | −0.263 | 0.194 | |
| | Interaction1 | 0.193 | 0.060 | 3.229 | 0.001 | 0.153 | 0.628 | |
| $H_6$ | Constant | 1.046 | 0.359 | 2.915 | 0.004 | 0.697 | 2.618 | $H_6$ is supported |
| | TR | −0.330 | 0.112 | −2.935 | 0.004 | 0.300 | 0.747 | |
| | Price | 0.670 | 0.083 | 8.099 | 0.000 | −0.551 | −0.109 | |
| | Interaction2 | 0.117 | 0.055 | 2.131 | 0.034 | 0.018 | 0.455 | |

Sustainable requirements (SR) and traditional requirements (TR).

sustainable perceived value and moderated by price sensitivity when customers purchase smartphones. The three main conclusions of this research are: First, the independent variables, which include sustainable requirements and traditional requirements, had a significant positive relationship with purchase intention. Second sustainable perceived value had a significant mediating effect on the relationship between the independent variables (sustainable requirements and traditional requirements) and purchase intention Third, price sensitivity did moderate the relationship between traditional requirements and purchase intention and it also reduced the negative effect of traditional requirements on purchase intention, while the moderating effect of price sensitivity on the relationship between sustainable requirements and purchase intention was not significant. Hence Companies that produce smartphones are recommended to use sustainable marketing to emphasize the hidden value of sustainable requirements with a green focus to help the consumers to understand the extra benefits and the added value of the spent money to contribute to protecting the environment.

The developed model in this study shows the relationship between five variables – sustainable requirements, traditional requirements, sustainable perceived value, and sustainable perceived value, with purchase intention and attempts to increase the success of products with sustainable product design in the market. With this model, product designers can incorporate sustainable product requirements at an early phase of the product design. This research also provides methods that can assist with the segmentation of the green smartphone market by identifying the demographic differences in the model's variables.

## 6.1. Theoretical implications

This study contributes to the literature on consumers' purchasing intention and adds to previous research on the correlation between sustainable purchase intention and sustainable design requirements, and it also contributes to advancing and expanding the research on this topic in China. The essential contribution of this research is the incorporation of variables like sustainable requirements, traditional requirements, sustainable perceived value, and price sensitivity to propose an advanced sustainable purchasing model. It also aims at finding the significant correlation between the independent variables (sustainable requirements, traditional requirements sustainable perceived value, and price sensitivity), and the dependent variables (sustainable purchasing intention). In this way, insights can be gained into the positive effect of sustainable purchasing as well as on sustainable requirements and traditional requirements.

## 6.2. Managerial implications

The findings show that demographic variables have a significant influence on sustainable smartphone purchasing intention. This finding might enable smartphone companies to segment the green market and develop effective sustainable marketing strategies. It helps companies to gain a deeper understanding of consumers who have a concern about the environment and sustainable design and develops more effective target customer marketing strategies. As well as the sustainable perceived value factors (social value, functional and emotional value) which could help companies decrease the possibility of new products failing in the market and increase opportunities for them to upgrade the features of new smartphones.

The proposed model in this research verified the positive impact of sustainable and traditional requirements on purchase intention. This could provide useful information for smartphone producers to design eco-friendly products and new marketing strategies that improve the requirements of the design and give it more attention than increasing their productivity.

And also the results of this research show a negative influence of price sensitivity on sustainable purchase intention so companies that produce smartphones are recommended to shift customers' attention and consideration toward the price of the smartphones with sustainable requirements by highlighting the importance and the value of sustainable design requirements such as safety, lower electromagnetic radiation, energy saving, easy maintenance, durability, information, and data security, etc.

## 6.3. Limitations and future research opportunities

There are two limitations to this research. First, we cannot generalize the results. The relationship between sustainable requirements, traditional requirements, sustainable perceived value, price sensitivity, and purchasing intention is experimentally tested on smartphones and tablets in China. The respondents were from China,

and the results could be different in other countries due to variations in the market, culture, and living standards. However, it is important to explore if the findings and conclusions can be applied to certain different other sustainable product designs and regions.

Future research could be conducted on different product designs and other regions. Second, this research was to investigate the relationship between sustainable requirements, traditional requirements, and sustainable purchasing intention, and only focus on the mediating effect of sustainable perceived value and the moderating effect of price sensitivity while excluding other possible mediating and moderating variables like brand loyalty and environmental consciousness. in future research, we will further refine the model and take moderating variables like brand loyalty and environmental consciousness into consideration in order to determine the relationship between sustainable requirements, traditional requirements, and purchase intention. Future studies could enhance this research results too by adding more factors such as brand and quality values.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## Author contributions

LH wrote the paper, collected the data, performed the analysis, conceived and designed the analysis, and contributed to data and analysis tools. LD reviewed the article. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



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# Appendix A: The questionnaire items.

| | | Items |
|---|---|---|
| **Sustainable requirements** | | 1. Smartphones must be recyclable.<br>2. Deference towards smartphones that are energy efficient.<br>3. Smartphones should be safe to use.<br>4. Smartphones should be easy to maintain.<br>5. There should be no toxic emissions or leakage risks.<br>6. Waste reduction is a priority.<br>7. Durable smartphones have more utility.<br>8. Preference for smartphones with lower SAR values.<br>9. Information and data security are extremely important. |
| **Traditional requirements** | Structure design requirements | 1. Preference for smartphones with screens with scratch protection and larger screen sizes.<br>2. The shape and color of smartphones should be pleasing to the eye.<br>3. Waterproofed smartphones are more preferable. |
| | Ease-to-use requirements | 1. Preference for a smartphone that is ergonomic, and thus easy to access.<br>2. Disassembly should be achievable, leading to easy repair. |
| | Performance requirements | 1. The screen resolution and quality of smartphones should be high.<br>2. Smartphones with larger memory capacity are preferable.<br>3. Reliability of the device is of great importance.<br>4. The smartphones are built solidly and shockproof.<br>5. The processing speed of smartphones should be high.<br>6. The battery must be long-lasting.<br>7. The device should not cause interference with other devices.<br>8. The device should be 5G compatible. |
| **Sustainable perceived values** | Functional value | 1. I prefer a smartphone with a variety of software apps for various uses<br>2. Get a significant value with the environmental features of smartphones. |
| | social value | 1. I'm looking to purchase the smartphones that my relatives, friends, or work colleagues have chosen.<br>2. Smartphones that are more environmentally friendly can improve how people see me. |
| | emotional value | 1. My smartphone makes me feel good.<br>2. I would like a smartphone since it is eco-friendly. |
| **Price sensitivity** | | 1. When it comes to purchasing a product, the price is the most essential consideration.<br>2. When purchasing a smartphone, the cheapest one is chosen.<br>3. All information and details are gathered on the price of the smartphone before purchasing. |
| **Purchase intention** | | 1. Intention to purchase a smartphone because it is concerned about the environment<br>2. Willingness to buy a smartphone is high. |

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# An experimental study on the potential purchase behavior of Chinese consumers of new energy hybrid electric vehicles

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The automotive industry has paid close attention to the promising future of new energy vehicles, and the new energy hybrid electric vehicles that fall under this category are gradually entering the public eye. This paper uses the SPSS software to conduct an experimental study on the "purchase preference for new energy hybrid vehicles" and its influencing factors of different types of consumers in China, based on 379 questionnaires and the results of situational experiments conducted by the research group in 24 cities across the country. The findings are as follows: 1) Different categories of consumers have a large gap in their cognitive preferences for new energy hybrid electric vehicles; 2) There is little difference in "purchase preference for new energy hybrid electric vehicles" among different categories of consumers; 3) The improvement of education and income has a significant effect on promoting consumers' "environmental awareness"; 4) Consumers' perception of the government's new energization policy is positive. Based on the preceding conclusions, this paper puts forward the policy recommendations to promote new energy hybrid electric vehicles.

KEYWORDS

**new energy hybrid electric vehicle, purchase preference, questionnaire survey method, one-way ANOVA, SNK test**

## 1 Introduction

With the development of the global economy and the growth of energy consumption, global greenhouse gas emissions continue to rise, and the energy crisis is becoming more severe, arousing high attention of the entire society. China is a major energy consumer, accounting for more than a quarter of global energy consumption. Oil is indispensable as the primary energy source for traditional vehicles (ICEVs). According to statistics, cars account for 57% of China's annual oil consumption. However, the massive loss of energy causes pollution and a scarcity of resources. Countries are developing and utilizing new energy to alleviate this problem, and vigorously developing new energy industry has become a global consensus. New energy has incomparable advantages over traditional energy because it is resource-rich and environmentally friendly. In recent years, new energy has gradually entered our lives, being used in a variety of fields, with new energy vehicles being a prime example. Various places have launched new energy vehicle implementation plans to boost the popularity of new energy vehicles since the promulgation of the New Energy Vehicle Production Enterprises and Product Access Management Rules in 2009. The introduction of new energy hybrid electric vehicles aided the development of the new energy vehicle industry. New energy hybrid electric vehicles maintain the benefits of energy

conservation and low emissions while partially addressing the issues of insufficient charging infrastructure and limited driving range. And new energy hybrid electric vehicles are set to become a significant trend in the growth of the automotive industry. Although new energy hybrid electric vehicles have numerous advantages, there are still concerns like high prices and decreased subsidies. The key to promoting new energy hybrid electric vehicles has progressively been whether consumers are willing to purchase them. Consequently, conducting prospective experimental research on the probable purchasing behavior of Chinese new energy hybrid vehicles has significant theoretical and practical significance in order to present the appropriate policy recommendations.

## 2 Literature review

As the driving force behind the automobile industry's future development, new energy vehicles bear the dual burdens of combating environmental pollution and the energy crisis, and their development status and prospects have piqued the interest of the government, businesses, and researchers. Domestic and international scholars are primarily concerned with the factors impeding the development and promotion of new energy vehicles. To begin with, most scholars agree that the cost, technical performance, and market acceptance of new energy vehicles are the most important factors to consider. Long et al. (2016) discovered that the primary factors influencing the booming sales of new energy vehicles are cost and charging infrastructure. According to the research of Xing and Wang (2010), the industrialization of essential technologies has not yet taken place, and the price of new energy vehicles is expensive. Palmer et al. (2018) investigated the market share and ownership costs of several vehicle models. Nodehi et al. (2022) suggested that battery life and energy efficiency will limit the development of new energy vehicles and that energy cost is one of the driving variables. Using the technology patent map, Xie et al. (2015) examined the technical data of three important new energy vehicle kinds in China: fuel cell, pure electric, and hybrid electric vehicles. Liu & Cheng (2014), who also studied new energy vehicle technology, made an in-depth analysis of energy consumption cost and business environment factors. Yuan et al. (2015) believed that the core technologies of new energy vehicles are not yet mature, and there are problems with the supply chain in the industrial sector and a small market share.

Furthermore, based on their research findings, various scholars have proposed other considerations that affect the development of new energy vehicles. Tang and Liu (2015) proposed infrastructure development as a factor to consider. Based on geospatial evidence from the United States, Kuming et al. (2016) investigated the effectiveness of government policies on the market sales of new energy vehicles. Meng et al. (2022) discovered that the dual-point policy could promote the development of the new-energy automobile industry. Qin and Xiong (2022) investigated the impact of non-financial policies on new energy vehicle innovation. In addition to the impact of policy factors, Fan et al. (2022) believed that consumer green preferences have an impact on the R&D and diffusion of new energy vehicles. Liu et al. (2020) investigated the strategic value and primary mode of battery reuse as significant challenges for the use of new-energy vehicle batteries.

The results of the available literature make it abundantly obvious that these various influencing variables still need to be addressed in order to promote the future diffusion of new energy cars. Additionally, these influencing variables will impact customer purchasing behavior to varying degrees. A portion of the literature is concerned with the outside forces that affect customer decisions. Chen et al. (2019) revealed that policies that are supportive can also indirectly improve customers' perception of economy. The policy statement, according to Xiong and Wang (2020), would aid in boosting customers' knowledge of the policy and purchase intent. Chan et al. (2014) looked into and contrasted how tax relief policies in China and the United States affected customers' decisions to buy new energy cars. According to Wang et al. (2020), regional characteristics, in addition to vehicle efficiency and national regulations, impact customer buying behavior. Wang et al. (2013) demonstrated that the intrinsic character of goods, government policy incentives, costs, reference groups, and symbolic elements of products all have a substantial effect on the private purchase of new energy vehicles. Li and Guo. (2022), Xu et al. (2023) and Mi et al. (2018) respectively analyzed consumers' purchasing behavior from the perspectives of safety and convenience of new energy vehicles, government subsidies and market acceptance of new energy vehicles, purchase intention, supporting facilities and economic cost.

In addition, some academics performed study from the viewpoint of actual consumers. Theoretically, Shen and Guo (2015) hypothesized that the vanity effect and the comparison effect may lead people to favor new energy cars. Consumer attitudes, subjective standards, and perceived behavioral control, according to Wang et al. (2021), play a crucial intermediary role in the acquisition of new energy cars. The results of Li et al. (2020) showed that consumers' comprehension of and reactions to present and future industrial policies and policy combos are academically significant in the field of new energy cars. Du et al. (2018) indicated that low carbon subjective cognition and low carbon objective cognition have distinct mechanisms for influencing customer purchasing behavior. Hao et al. (2016) performed a questionnaire poll in seven Chinese towns and discovered that consumers' monthly income, family vehicle possession, and the sustainability and convenience of vehicle use all had a significant influence on their buying behavior. Based on policies, vehicle performance, and consumer characteristics, Xian et al. (2022) concluded that tax exemption policies can improve consumers' purchase intention, and that consumers with commuting needs have higher purchase intention. Zhao et al. (2022) discovered that personal norms and green self-identity are positively correlated with purchase intention. Li and Guo (2022), Li et al. (2021), Sun and Xu (2018), Wang et al. (2021), and other scholars have conducted detailed studies on different types of consumers' consumption preferences from multiple perspectives.

At present, there are many literatures on new energy vehicles, but domestic researches on new energy hybrid electric vehicles are relatively few. While foreign scholars mostly start from the technical performance of new energy hybrid electric vehicles to study the improvement strategy of vehicles (Mesbahi T et al., 2014; Buccoliero G et al., 2019; Arevalo et al., 2020), research literature on the purchasing behavior of consumers of new energy hybrid electric vehicles is relatively rare.

In light of this, this paper analyzes 379 questionnaires from 24 cities across China using one-way ANOVA, independent sample *t*-test, and SNK test to reveal the potential purchasing behavior of different types of consumers (demographic variables) of new energy hybrid vehicles in China, as well as to provide a small supplement to the study of new energy hybrid electric vehicles. This paper aims to reveal the influence mechanism of different types of consumers' potential new energy hybrid electric vehicle purchasing behavior, and to provide a foundation for relevant government departments to adopt incentive policies and measures to promote the consumption of new energy hybrid electric vehicles and to realize incentive policy measures for new energy vehicles.

# 3 Research methods and sample data

## 3.1 Research methods

The research methods used in this paper include literature review, questionnaire survey, situational experiment and statistical analysis.

(1) Literature review: This paper continues to track the frontier dynamics of domestic and international research on the purchase behavior of new energy hybrid vehicles through in-depth mining and analysis of relevant literature. Simultaneously, it seeks entry points for future research based on the current situation and scarcity of research on the consumption of new energy hybrid vehicles in China.

(2) Questionnaire survey: From the five dimensions of consumers' "environmental awareness," "cognition of new energy hybrid electric vehicles," "cognition preference for new energy hybrid electric vehicles," "evaluation of the current situation of new energy hybrid electric vehicles" and "purchase preference for new energy hybrid electric vehicles," this paper adopts the questionnaire survey to measure the relevant variables. The questionnaire is filled out by the respondents in the selected locations of the sample cities in accordance with the random principle to ensure the reliability of the questionnaire data.

(3) Scenario experiment: In the absence of actual payment, consumers' "new energy hybrid electric vehicle purchase behavior" may be affected by such factors as industry, income level, age, region, education level and other similar factors, thus compromising the reliability of the study. This paper introduces the scenario experiment method for hypothetical measurement. In this experiment, paired samples are collected after consumers complete the questionnaire and they filled out the questionnaire one by one. The situational experiment method adopted in this study is divided into two steps:

The first step is to select part of the questionnaire questions related to consumers' purchase behavior of new-energy hybrid electric vehicles and set the score and proportion of each question (the five questions of industry, age, monthly income, residence and education level account for 20% each).

The second step is to mark the questions in accordance with the pre-designed questions, that is, to check the five options of industry, age, monthly income range, residence and education level, and to sum up the scores. Following the completion of the statistics, the consumers' consumption capacity of new energy hybrid electric vehicles is estimated based on the calculated score.

(4) Statistical analysis: In this paper, SPSS statistical analysis software is used, and independent sample T-test and one-way ANOVA are adopted. The differences of 379 consumers from 24 cities in "environmental protection awareness," "cognition of new energy hybrid electric vehicles," "cognition preference for new energy hybrid electric vehicles," "evaluation of the current situation of new energy hybrid electric vehicles" and "purchase preference for new energy hybrid electric vehicles" are quantitatively analyzed. Through the regression model, the moderating effect of policy variables on "new energy hybrid electric vehicle purchase behavior" is tested in order to reveal the potential law of Chinese consumers' new energy hybrid electric vehicle purchase behavior.

## 3.2 Sample data

(1) Questionnaire design

This study adopts the form of structured interview questionnaire, in which 17 structured questions are designed and divided into 5 dimensions. They are "consumers' environmental awareness," "consumers' cognition of new energy hybrid electric vehicles," "consumers' cognitive preference for new energy hybrid electric vehicles," "consumers' evaluation of the current situation of new energy hybrid electric vehicles" and "consumers' purchase preference for new energy hybrid electric vehicles". All the above 17 indicators are designed using five-point Likert scale (Table 1).

(2) Sample attributes

The data used in this paper are all from the Guangdong research group's questionnaire and situational experiment data. Given the epidemic situation, this survey was carried out by combining online questionnaire distribution with an offline field survey. The sample data were collected from first-tier cities (Guangzhou, Shenzhen, Dongguan, Foshan), second-tier cities (Huizhou, Zhuhai, Zhongshan), third-tier cities (Shantou, Jiangmen, Zhanjiang, Chaozhou, Qingyuan, Zhaoqing), and fourth-tier cities (Maoming, Shaoguan, Shanwei), which are widely representative in terms of economic development and population distribution. Guangdong is a province with strong population mobility. Besides Guangdong Province, the data sources of the samples include Hunan Province (Changsha City, Chenzhou City, Changde City, Yongzhou City, Huaihua City, Yueyang City and Yiyang City), Hebei Province (Shijiazhuang City, Handan City, Xingtai City, Baoding City and Langfang City), Shanxi Province (Datong City, Yangquan City, Shuozhou City and Linfen City), Inner Mongolia City (Hohhot City), Heilongjiang Province (Hegang City, Jiamusi City and Suihua City), Jiangxi (Nanchang City, Xinyu City, Yichun City and Shangxiao City), Shandong (Jinan City, Zibo City, Zaozhuang City, Yantai City and Jining City), Henan (Zhengzhou City, Nanyang city and Shangqiu City), Guangxi

**TABLE 1 17 indicators of five-point Likert scale in the questionnaire.**

| The dimension | Index of measurement | Option |
|---|---|---|
| 1. Environmental awareness | (1) The degree of awareness of the hazards of traditional automobile lifestyle | No effect = 1; Not serious = 2; Generally = 3; Severe = 4; Quite serious = 5 |
| | (2) Recognition of the necessity of national new energy hybrid vehicle promotion | Completely unnecessary = 1; Not necessary = 2; Generally = 3; Necessary = 4; Very necessary = 5 |
| | (3) Awareness of self-environmental protection behavior in daily life | Assigned according to the degree of environmental awareness |
| | (4) Recognition of the application prospect of new energy hybrid electric vehicles | Pessimistic = 1; Relatively pessimistic = 2; Generally = 3; More optimistic = 4; Very optimistic = 5 |
| | (5) Recognition of the impact of policy orientation on the promotion of new energy hybrid vehicles | Not important = 1; Not important = 2; Generally = 3; More important = 4; Very important = 5 |
| 2. Cognition of new energy hybrid electric vehicles | (6) The degree of understanding of the basic policies of new energy hybrid electric vehicles | I've never heard of = 1; I occasionally hear that = 2; Basic knowledge = 3; Have a better understanding of; = 4; Well, that's equal to 5 |
| | (7) The degree of cognition of subsidy policies for new energy hybrid electric vehicles | I don't know anything about = 1; I don't know that well = 2; Usually = 3; Well know = 4; Well, that's equal to 5 |
| | (8) Cognition of new energy hybrid electric vehicles | I don't know anything about = 1; I don't know that well = 2; Usually = 3; Well know = 4; Well, that's equal to 5 |
| | (9) The degree of cognition of new-energy hybrid electric vehicle technology | I don't know anything about = 1; I don't know that well = 2; Usually = 3; Well know = 4; Well, that's equal to 5 |
| 3. Cognitive preference for new energy hybrid electric vehicles | (10) The cognition degree of different kinds of new energy vehicles | Multiple choice, based on the number of correct answers |
| | (11) The degree of cognition of all kinds of new energy | |
| 4. Evaluation of the current situation of new-energy hybrid electric vehicles | (12) Evaluation of new energy hybrid electric vehicle technology | Multiple choice, based on the number of correct answers |
| | (13) Evaluation of the new energy hybrid electric vehicle market | |
| | (14) Evaluation of the government's market management of new energy hybrid electric vehicles | |
| 5. Preference for new energy hybrid electric vehicles | (15) Willingness to buy new energy hybrid electric vehicles | Assign values according to intentionality strength |
| | (16) Willingness to use new energy hybrid electric vehicles | |
| | (17) The willingness to buy new energy hybrid electric vehicles under government subsidies | According to the acceptable price of new energy vehicles assigned value |

Data source: Based on the design and compilation of the research group.

(Liuzhou City), Sichuan (Chengdu City, Zigong City and Mianyang city) and Chongqing Municipality total 54 regions. In order to better explain the classification, the above regions were divided into sub-provincial and prefecture-level. Questionnaire data were collected in accordance with the random principle, and questionnaires were randomly distributed in densely populated places such as supermarkets, apartments, office buildings, and family homes in various cities. Our research group sent out a total of 400 questionnaires and recovered 383 questionnaires, for a recovery rate of 95.75%. Among them, 379 were valid, with an effective recovery rate of 98.96%. Males 209 account for 55.15% of the 379 samples; females 170 account for 44.85%. The distribution of population income and age in the regions involved in the sample is relatively balanced, which can reflect the basic characteristics of Chinese consumers and has good representativeness (Table 2).

(3) Reliability and validity test of data

After obtaining the data of the interview questionnaire, this paper uses SPSS 26.0 to conduct factor analysis on the 17 Likert scale indicators in the questionnaire. The results show that: ①The KMO value is 0.784, indicating that the data has good validity (Table 3). ②The 17 indicators are divided into 5 dimensions (Table 4). In addition, this paper analyzes the internal consistency of the data according to five different dimensions. The results show that the α value of the first dimension (consumers' environmental awareness) is 0.740, the α value of the second dimension (consumers' cognition of new energy hybrid electric vehicles) is 0.783, and the α value of the third dimension (consumers' cognition preference for new energy hybrid electric vehicles) is 0.703. The α value of the fourth dimension (consumers' evaluation of the current situation of new energy hybrid electric vehicles) is 0.717, and the α value of the fifth dimension

**TABLE 2 Sample attributes of the questionnaire.**

| | Frequency | Proportion (%) | | Frequency | Proportion (%) |
|---|---|---|---|---|---|
| 1.Gender | | | 3.Monthly income | | |
| Male | 209 | 55.15 | Less than 999 yuan | 27 | 7.12 |
| Female | 170 | 44.85 | 1000-2999yuan | 46 | 12.14 |
| 2. Region | | | 3000-4999yuan | 90 | 23.75 |
| Deputy provincial level | 87 | 22.96 | 5000-6999yuan | 91 | 24.01 |
| Prefectural level | 292 | 77.04 | More than 7000 yuan | 125 | 32.98 |
| | | | 4.Age | | |
| | | | Age 19 and under | 21 | 5.54 |
| | | | 20–29 years old | 135 | 35.62 |
| | | | 30–39 years old | 91 | 24.01 |
| | | | 40–49 years old | 76 | 20.05 |
| | | | Age 50 and above | 56 | 14.78 |

Data source: The author obtained the data based on the statistical analysis of sample data from questionnaire survey and situational experiment.

**TABLE 3 KMO and spherical Bartlett tests of 17 variables.**

| | Index of inspection | Results of inspection |
|---|---|---|
| KMO test | | 0.784 |
| Bartlett test | Approximate chi square | 1767.827 |
| | Degree of freedom | 136 |
| | Significance | 0 |

Data source: The author obtained the data based on the statistical analysis of sample data from questionnaire survey and situational experiment.

(consumers' purchase preference for new energy hybrid electric vehicles) is 0.690. Hence, the scale data exhibit good internal consistency (Table 5).

# 4 Test results and analysis

Based on the information gathered by the research team, this paper applied the one-way ANOVA SNK test (commonly known as the "Student's t-test") method using SPSS 26.0 software. The "environmental awareness," "cognition of new energy hybrid electric vehicles," "cognitive preference for new energy hybrid electric vehicles," "assessment of the current situation of new energy hybrid electric vehicles," and "purchase preference for new energy hybrid electric vehicles" are all conducted, respectively, among consumers in various regions, age groups, educational levels, income levels, genders, and occupations. In order to examine the significance of differences between several groups, an independent sample SNK test was conducted.

The paper performed the normality test on the sample data to confirm that the SNK test was feasible before performing the one-way ANOVA test. The findings demonstrate that the normal plot has a bell shape with a high center and a low end, which is generally recognized as a normal distribution. The histogram of the normality test for each group is displayed in Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, Figure 6.

## 4.1 Analysis of different regions

According to the sub-provincial and prefectural level regions divided by 54 regions in the survey data, we first conducted SNK tests on the "purchase preference for new energy hybrid electric vehicles" of consumers in different regions and the four dimensions that affect the purchase preference for new energy hybrid electric vehicles (Table 6). The findings indicate that.

(1) The "environmental consciousness" of customers in sub-provincial and prefectural level locations varies just slightly. The terms "cognition of new energy hybrid electric vehicles," "assessment of the status quo of new energy hybrid electric vehicles," and "cognitive preference for new energy hybrid electric vehicles" all differ significantly. In addition to the cognition of new energy hybrid electric vehicles, the sub-provincial consumers are better than the prefecture level consumers in other four indicators. Consumers in the area have better economic backgrounds and more affluent lifestyles, which results in a sub-provincial level of economic development that is significantly higher.

**TABLE 4 Factor load matrix of 17 variables after orthogonal rotation.**

| Variable | Environmental awareness | Cognition of new energy hybrid electric vehicles | Cognitive preference for new energy hybrid electric vehicles | Evaluation of the *status quo* of new energy hybrid electric vehicles | The purchase preference for new energy hybrid electric vehicles |
|---|---|---|---|---|---|
| Awareness of the necessity of promoting national new energy hybrid electric vehicles | 0.721 | | | | |
| Awareness of self–environmental behavior in daily life | 0.698 | | | | |
| The level of awareness of the hazards of the traditional automobile lifestyle | 0.687 | | | | |
| Awareness of the application prospect of new energy hybrid electric vehicles | 0.688 | | | | |
| Understanding of the influence degree of policy orientation on the promotion of new energy hybrid electric vehicles | 0.574 | | | | |
| Awareness of the basic policies of new energy hybrid electric vehicles | | 0.751 | | | |
| Awareness of subsidy policies for new energy hybrid electric vehicles | | 0.784 | | | |
| The degree of cognition of new energy hybrid electric vehicles | | 0.720 | | | |
| The degree of cognition of new energy hybrid electric vehicle technology | | 0.773 | | | |
| The cognition degree of different kinds of new energy vehicles | | | 0.906 | | |
| Awareness of various new energy sources | | | 0.864 | | |
| Evaluation of new energy hybrid electric vehicle technology | | | | 0.814 | |
| Evaluation of the new energy hybrid electric vehicle market | | | | 0.771 | |
| Evaluation of the government's market management of new energy hybrid electric vehicles | | | | 0.787 | |
| The willingness to buy new energy hybrid electric vehicles | | | | | 0.826 |
| The willingness to buy new energy hybrid electric vehicles with government subsidies | | | | | 0.733 |
| The willingness to use new energy hybrid electric vehicles | | | | | 0.529 |

Data source: The author obtained the data based on the statistical analysis of sample data from questionnaire survey and situational experiment.

(2) Consumers in sub-provincial areas have lower cognition of new energy hybrid electric vehicles. The sub-provincial level is more developed, and it is more responsible for leading the society's new green trend. Furthermore, consumers in the region have more opportunities to interact with the new energy hybrid electric vehicle industry, but survey results show that

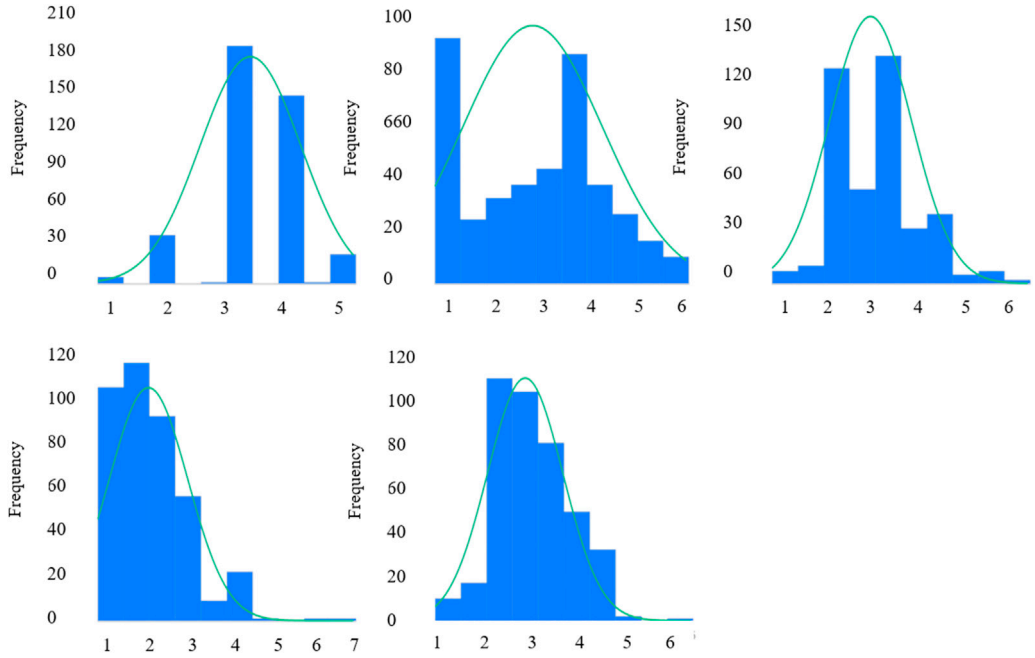


FIGURE 1
Normality test histograms for different regions.

**TABLE 5 Reliability test of the questionnaire.**

| Item | Cronbach's Alpha |
|---|---|
| Environmental awareness of consumers | 0.740 |
| Consumers' cognition of new energy hybrid electric vehicles | 0.783 |
| Consumers' cognitive preference for new energy hybrid electric vehicles | 0.703 |
| Consumers' evaluation of the current situation of new-energy hybrid electric vehicles | 0.717 |
| Consumers' purchase preference for new-energy hybrid electric vehicles | 0.690 |

Data source: The author obtained the data based on the statistical analysis of sample data from questionnaire survey and situational experiment.

consumers in the region have a poor understanding of all aspects of new energy hybrid electric vehicles. The government and other relevant departments should pay attention to this. All departments, in particular, must focus on policy guidance and the popularization of more relevant knowledge.

## 4.2 Analysis of different age groups

We conducted SNK tests on the "purchase preference for new energy hybrid electric vehicles" of consumers of different ages and the four dimensions that affect the purchase behavior of new energy hybrid electric vehicles (Table 7). The results show that.

(1) In contrast to the relatively small difference in "purchase preference for new energy hybrid electric vehicles," there is a substantial difference between "cognition of new energy hybrid electric vehicles" and "cognitive preference for new energy hybrid electric vehicles" among all age groups. In terms of "cognitive preference for new energy hybrid electric vehicles," there is a significant difference between the age groups of under 19 years old, 30–39 years old, and other age groups, with a difference of 103.05% between the group with the largest mean (under 19 years old) and the group with the smallest mean (30–39 years old) (significance level is 0.05). This demonstrates that there is a significant age difference in Chinese residents' preferences for new-energy hybrid vehicles, and there is no positive correlation between age and cognitive degree, indicating that these preferences are more likely to be influenced by an individual's personal library of pertinent information. Although there are substantial variations in group cognition, most individuals have a high level of environmental awareness. Age-related preferences for new energy hybrid electric cars are thus consistent across age groups.
(2) Young and middle-aged individuals (30–39 years old) have the lowest opinion of the *status quo* of new energy hybrid electric vehicles, but have the highest purchase preference. At this stage, the group personalities tend to be mature, rich in life and work experience, and are more concerned with social issues. At present, there are numerous difficulties and impediments to the widespread adoption of new energy hybrid electric cars. This group is concerned about the development prospects of new energy hybrid electric vehicles, but they have a greater awareness of the environment and social responsibility, which makes them more willing to purchase new energy hybrid vehicles.

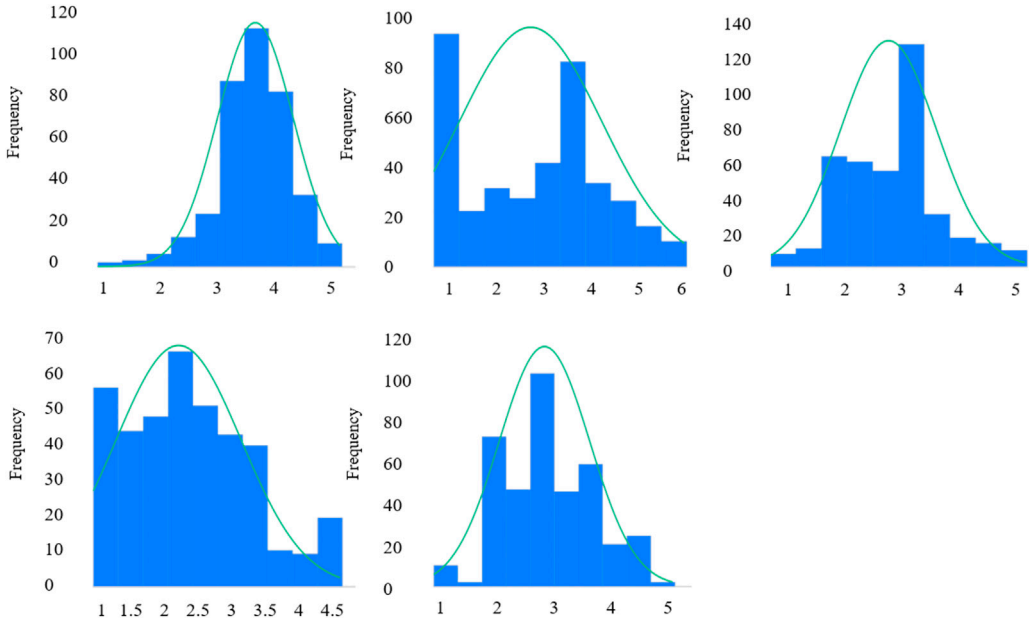


FIGURE 2
Normality test histogram for different age groups.

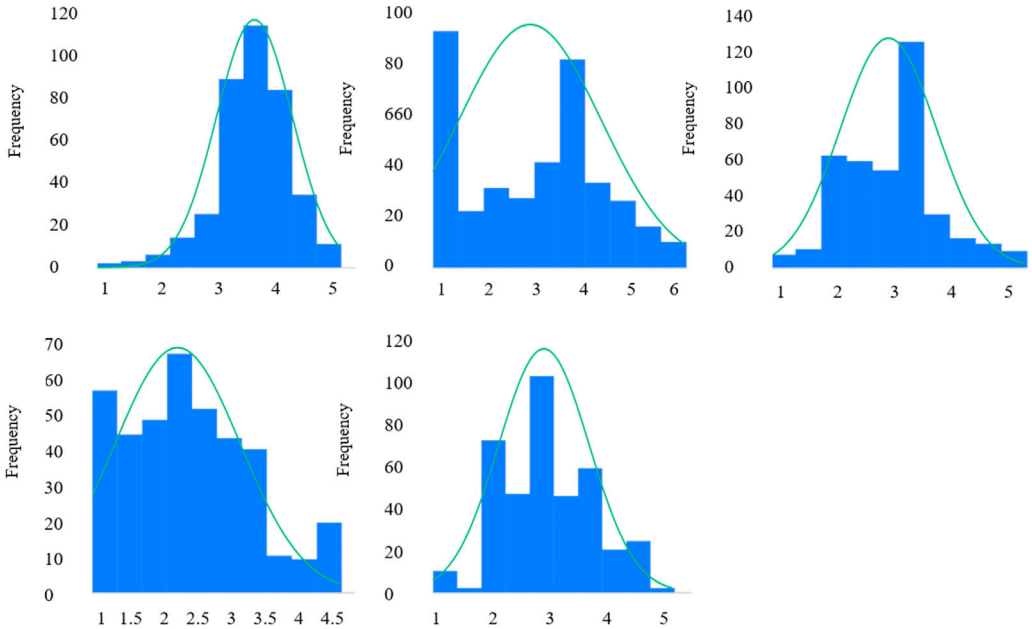


FIGURE 3
Normality test histograms for different educational levels.

(3) Young individuals (20–29 years old) have the weakest environmental consciousness. Young people have completed basic school requirements or even more advanced coursework. They are commonly highly educated and generally have a strong sense of responsibility to society. The unexpected nature of the poll results, however, should prompt societal reflection and increased attention from the government, schools, and other pertinent agencies. Measures should be taken to address the causes in addition to examining the root reasons.

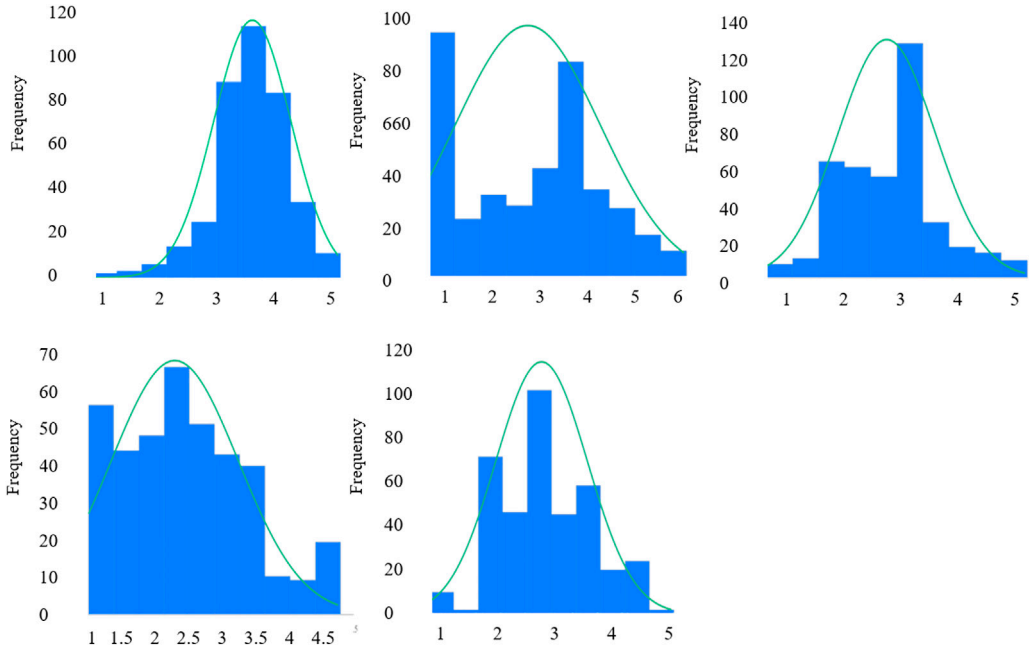


FIGURE 4
Normality test histogram for different income levels.

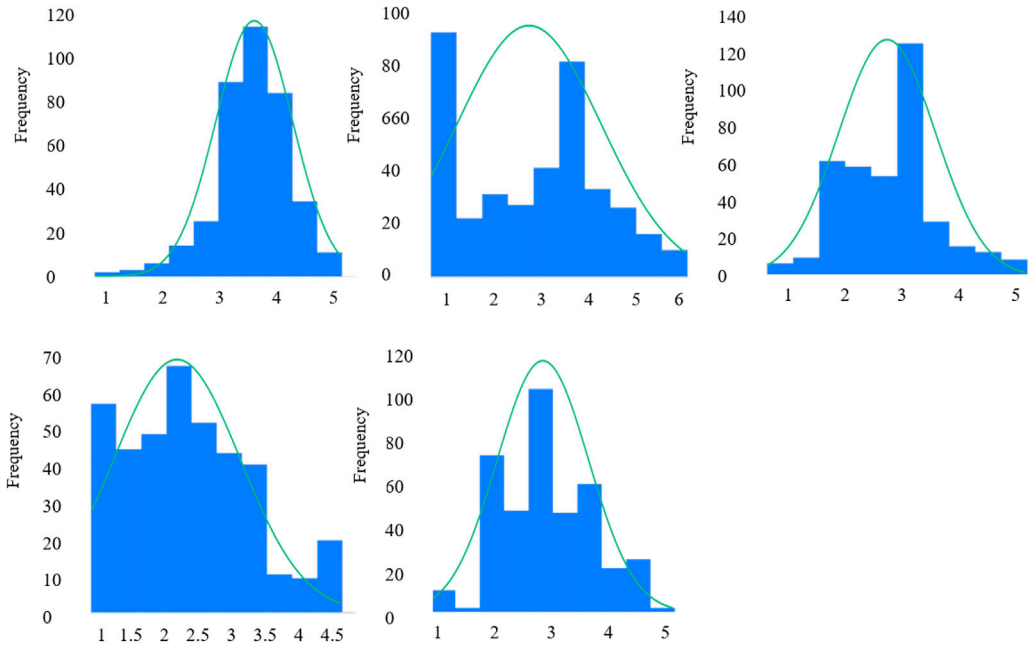


FIGURE 5
Normality test histograms for different industries.

## 4.3 Analysis of different educational levels

We conducted SNK tests on the "purchase preference for new energy hybrid electric vehicles" of consumers with different education levels and the four dimensions that affect the purchase preference for new energy hybrid electric vehicles (Table 8). The results show that.

(1) The "cognition of new energy hybrid electric vehicles," "cognitive preference for new energy hybrid electric vehicles,"

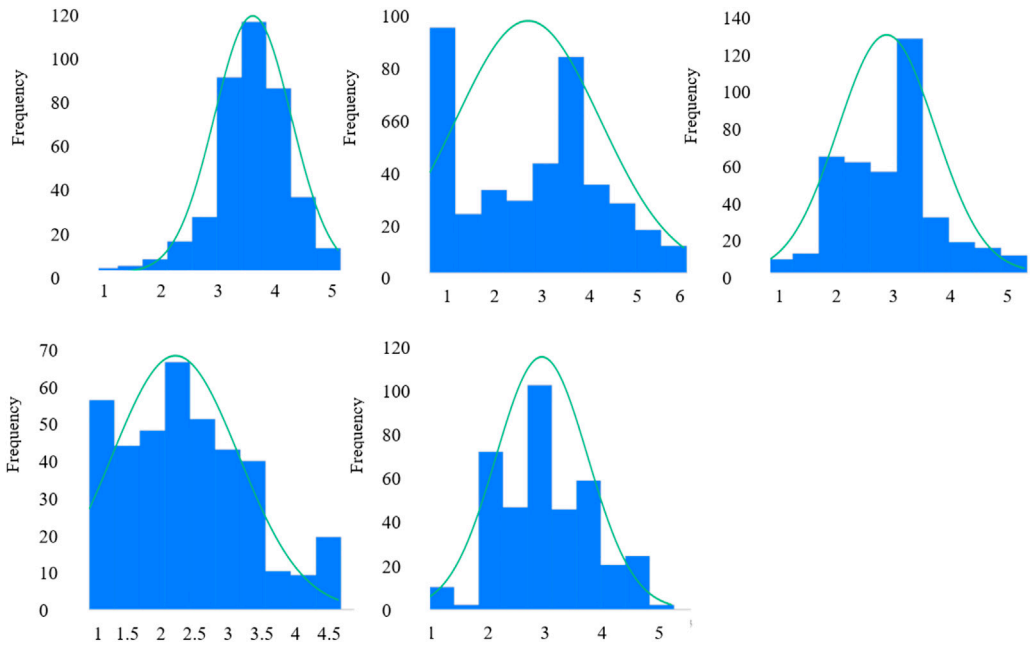


FIGURE 6
Normality test histograms for different genders.

**TABLE 6 T-test results of independent samples in different regions.**

| Item | Deputy provincial level | | | Prefectural level | | | t | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std Deviation | Std Error mean | Mean | Std Deviation | Std Error mean | | |
| Environmental awareness | 3.480 | 0.592 | 0.063 | 3.442 | 0.592 | 0.035 | 0.525 | 0.600 |
| Cognition of new energy hybrid electric vehicles | 2.606 | 0.723 | 0.078 | 2.751 | 0.693 | 0.041 | −1.731 | 0.084 |
| Cognitive preference for new energy hybrid electric vehicles | 2.948 | 1.698 | 0.182 | 2.101 | 1.638 | 0.096 | 4.199 | 0.000 |
| Evaluation of the *status quo* of new energy hybrid electric vehicles | 2.318 | 0.818 | 0.877 | 2.088 | 0.838 | 0.049 | 2.261 | 0.024 |
| The purchase preference for new energy hybrid electric vehicles | 2.923 | 0.774 | 0.830 | 2.820 | 0.736 | 0.043 | 1.140 | 0.255 |

Data source: The author obtained the data based on the statistical analysis of sample data from questionnaire survey and situational experiment. Remarks: A, B, C and D in the table represent the grouping of samples by student t test respectively; A represents the optimal group and D represents the worst group. Subscripts 1, 2, 3, 4, 5 and 6 represent intra-group ranking, 1 represents the optimal intra-group ranking and 6 represents the lowest intra-group ranking. And so on.

and "purchase preference for new energy hybrid electric vehicles" differ significantly among customers with varying levels of education. While there is no significant difference in cognition among groups of consumers with other education levels, consumers with the highest education level, a master's or higher, have a significantly different cognition and cognitive preference for new energy hybrid electric vehicles compared to consumers with other education levels. This suggests that education has little effect on consumers' cognition and preference for new energy hybrid electric vehicles. Individual subjective opinion, however, weighs more heavily. Across all age groups, this is also accurate. Consumers with the highest level of education of bachelor's degree or above have greater cognition and cognitive preference for new energy hybrid electric vehicles, and consequently have higher purchase preference.

(2) There is little variation between groups in terms of "environmental awareness" and "evaluation of the current situation of new energy hybrid electric vehicles" among

**TABLE 7 Test results and ranking of different age groups.**

| Item | Age 19 and under | 20–29 years old | 30–39 years old | 40–49 years old | Age 50 and above | Variance between groups | Relative percentage (%) |
|---|---|---|---|---|---|---|---|
| | Score | Score | Score | Score | Score | | |
| Environmental awareness | $A_1$ (3.69) | $A_5$ (3.39) | $A_2$ (3.50) | $A_3$ (3.45) | $A_4$ (3.44) | 0.455 | 8.85 |
| Cognition of new energy hybrid electric vehicles | $B_3$ (2.56) | $B_2$ (2.62) | A (3.09) | $B_1$ (2.66) | $B_4$ (2.50) | 17.323 | 23.60 |
| Cognitive preference for new energy hybrid electric vehicles | A (3.33) | $B_2$ (2.48) | C (1.64) | $B_3$ (2.28) | $B_1$ (2.54) | 2.027 | 103.05 |
| Evaluation of the *status quo* of new energy hybrid electric vehicles | $A_2$ (2.22) | $A_3$ (2.18) | $A_5$ (2.01) | $A_1$ (2.23) | $A_4$ (2.11) | 0.660 | 10.95 |
| The purchase preference for new energy hybrid electric vehicles | $A_2$ (2.89) | $A_3$ (2.85) | $A_1$ (3.04) | $A_4$ (2.79) | B (2.57) | 4.404 | 18.29 |

Data source: The author obtained the data based on the statistical analysis of sample data from questionnaire survey and situational experiment.

**TABLE 8 Test results and ranking of different educational levels.**

| Item | Junior high school and below | Technical school/ secondary school/ vocational high school/high school | Specialized subject | Undergraduate course | Master degree or above | Variance between groups | Relative percentage (%) |
|---|---|---|---|---|---|---|---|
| | Score | Score | Score | Score | Score | | |
| Environmental awareness | $A_3$ (3.38) | $A_4$ (3.38) | $A_5$ (3.30) | $A_2$ (3.51) | $A_1$ (3.59) | 0.877 | 8.79 |
| Cognition of new energy hybrid electric vehicles | $B_4$ (2.48) | $B_3$ (2.51) | $B_2$ (2.70) | $B_1$ (2.79) | $A_1$ (2.92) | 10.855 | 17.74 |
| Cognitive preference for new energy hybrid electric vehicles | $B_1$ (2.66) | $B_3$ (2.14) | $B_4$ (1.80) | $B_2$ (2.31) | A (3.02) | 1.422 | 67.77 |
| Evaluation of the *status quo* of new energy hybrid electric vehicles | $A_3$ (2.15) | $A_2$ (2.16) | $A_5$ (2.07) | $A_4$ (2.13) | $A_1$ (2.27) | 0.277 | 9.66 |
| The purchase preference for new energy hybrid electric vehicles | $B_3$ (2.74) | $B_4$ (2.65) | $B_2$ (2.79) | $B_1$ (2.89) | A (3.07) | 1.757 | 15.85 |

Data source: The author obtained the data based on the statistical analysis of sample data from questionnaire survey and situational experiment.

consumers with varying levels of education. In terms of "environmental awareness," the mean gap between the highest (master's degree or above) and the lowest (junior college) levels is 8.79%. The marginal difference between the categories suggests that Chinese citizens' overall environmental protection awareness has increased. The highest education level (master's degree or above) and the lowest education level (high school) are the mean values for "Evaluation on the current situation of new-energy hybrid electric vehicles," and there is no discernible difference between the two. There is still a long way to go before new-energy hybrid electric vehicles are widely adopted in China due to the country's residents' apparent lack of trust in the market.

## 4.4 Analysis of different income levels

SNK test was conducted on the "purchase preference for new energy hybrid electric vehicles" of consumers with different income levels and the four variable dimensions that affect the purchase

**TABLE 9 Test results and ranking of different income levels.**

| Item | Below 999 yuan | 1000–2999 yuan | 3000–4999 yuan | 5000–6999 yuan | More than 7000 yuan | Variance between groups | Relative percentage (%) |
|---|---|---|---|---|---|---|---|
| | Score | Score | Score | Score | Score | | |
| Environmental awareness | $A_3$ (3.39) | $A_1$ (3.33) | $A_2$ (3.34) | $A_5$ (3.55) | $A_4$ (3.52) | 0.801 | 6.61 |
| Cognition of new energy hybrid electric vehicles | $A_1$ (2.41) | $A_2$ (2.48) | $B_1$ (2.69) | $B_2$ (2.71) | $B_3$ (2.98) | 2.808 | 23.65 |
| Cognitive preference for new energy hybrid electric vehicles | $A_4$ (2.61) | $A_3$ (2.35) | $A_1$ (1.77) | $A_2$ (2.25) | $A_5$ (2.62) | 10.329 | 48.02 |
| Evaluation of the *status quo* of new energy hybrid electric vehicles | $A_3$ (2.19) | $A_5$ (2.31) | $A_1$ (1.98) | $A_2$ (2.14) | $A_4$ (2.19) | 1.021 | 16.67 |
| The purchase preference for new energy hybrid electric vehicles | $B_3$ (3.06) | $A_1$ (2.66) | $A_2$ (2.67) | $B_1$ (2.86) | $B_2$ (2.97) | 1.905 | 15.04 |

Data source: The author obtained the data based on the statistical analysis of sample data from questionnaire survey and situational experiment.

preference for new energy hybrid electric vehicles (Table 9). The results show that.

(1) "Cognition of new energy hybrid electric vehicles" is positively correlated with income level. Income significantly influences "cognition of new energy hybrid electric vehicles," as shown in Table 9. The highest group's mean number for "cognition of new energy hybrid electric vehicles" is 23.65% higher than the lowest group's, and there is a variance of 2.808 between the two groups. Consumers with monthly incomes below 2999 yuan and those with monthly incomes above 3000 yuan are divided into two groups based on their "cognition of new energy hybrid electric vehicles" using the SNK test results from SPSS 26.0 at the significant level of 0.05. The mean value of "cognition of new energy hybrid electric vehicles" for consumers with a monthly income of more than 7,000 is the highest, while the mean value for consumers with a monthly income of less than 999 is the lowest. The bulk of the samples earning less than 999 yuan per month are college students with limited financial resources. It is usual for them to earn less than 1000 yuan per month. Furthermore, as living standards in China improve, as do inflation and other factors, the number of middle- and high-income people increases, and they are more interested in new energy and new technology, as well as having a strong ability to pay. Therefore, the cognition of new energy hybrid electric vehicles and their income level change positively.

(2) The largest disparity in "cognitive preference for new energy hybrid electric vehicles" is observed among customers of different socioeconomic levels. The difference between the highest and lowest mean values of "cognitive preference for new energy hybrid electric vehicles" is 48.02%, and the inter-group variance is also large compared with other indicators in the group, which is 10.329. Consumer groups have significant differences in cognitive preference for new energy hybrid electric vehicles, according to the inter-group classification of SNK test findings, with a monthly income of 3,000 yuan as the boundary. This reflects that when the average monthly income of consumers is between 3000 and 4999 yuan, their cognitive preference for new energy hybrid electric vehicles is relatively vague. Consumers with an average monthly income of less than 3000 yuan and more than 4999 yuan, on the other hand, have a comparable cognitive preference for new energy hybrid electric vehicles. From the standpoint of the development level of new energy hybrid electric vehicles in China, it should be the general trend to popularize the types of new energy and promote new energy vehicles, implement the policy of high-income group to purchasing new energy vehicles and implement the subsidy policy of low-income group consumers to purchasing new energy vehicles.

(3) Consumers with different income levels have small differences in "purchase preference for new energy hybrid electric vehicles" and "evaluation on the *status quo* of new energy hybrid electric vehicles," and no significant differences in "environmental awareness." As shown in Table 9, the relative difference between the mean values of the above indicators is 15.04%, 16.67%, and 6.61% respectively, and the variances between groups of different income levels are 1.905, 1.021, and 0.801. Except for environmental awareness, the mean value of each indicator and income does not change in the same direction. This indicates that increasing income or increasing subsidies has no obvious effect on improving residents' environmental awareness, nor can it significantly affect consumers' purchase preference for new-energy hybrid electric vehicles.

**TABLE 10 Test results and ranking of different industries.**

| Item | Traditional energy industry | New energy industry | The construction industry | Service industry | The financial industry | Education industry | Government organs and institutions | Information industry | Mining industry | Manufacturing | Agriculture, forestry, husbandry and fishing industries | Other | Variance between groups | Relative percentage (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Score | Score | Score | Score | Score | Score | Score | Score | Score | Score | Score | Score | | |
| Environmental awareness | $A_9$ (3.50) | $A_4$ (3.31) | $A_1$ (3.04) | $A_3$ (3.26) | $A_5$ (3.37) | $A_{12}$ (3.71) | $A_8$ (3.50) | $A_7$ (3.48) | $A_{11}$ (3.70) | $A_6$ (3.47) | $A_2$ (3.17) | $A_{10}$ (3.66) | 1.156 | 22.04 |
| Cognition of new energy hybrid electric vehicles | $A_{11}$ (2.82) | $B_1$ (3.38) | $A_4$ (2.63) | $A_2$ (2.58) | $A_5$ (2.70) | $A_7$ (2.72) | $A_8$ (2.77) | $A_9$ (2.78) | $A_3$ (2.63) | $A_{10}$ (2.79) | $A_6$ (2.71) | $A_1$ (2.52) | 0.926 | 34.13 |
| Cognitive preference for new energy hybrid electric vehicles | $A_1$ (0.21) | $A_2$ (0.92) | $A_3$ (1.23) | $C_1$ (2.77) | $C_3$ (2.84) | $C_7$ (3.33) | $C_5$ (3.12) | $C_8$ (3.35) | $C_4$ (3.00) | $C_2$ (2.84) | $B_1$ (1.67) | $C_6$ (3.21) | 46.884 | 1495.24 |
| Evaluation of the *status quo* of new energy hybrid electric vehicles | $A_6$ (2.16) | $A_2$ (1.82) | $A_8$ (2.17) | $A_9$ (2.20) | $A_7$ (2.16) | $A_4$ (2.05) | $A_5$ (2.13) | $A_{11}$ (2.50) | $A_1$ (1.67) | $A_3$ (1.92) | $A_{12}$ (2.56) | $A_{10}$ (2.23) | 0.626 | 53.29 |
| The purchase preference for new energy hybrid electric vehicles | $A_9$ (2.94) | $A_{12}$ (3.28) | $A_3$ (2.67) | $A_2$ (2.65) | $A_6$ (2.88) | $A_7$ (2.91) | $A_1$ (2.59) | $A_8$ (2.93) | $A_4$ (2.75) | $A_{10}$ (2.95) | $A_5$ (2.78) | $A_{11}$ (2.99) | 0.948 | 26.64 |

Data source: The author obtained the data based on the statistical analysis of sample data from questionnaire survey and situational experiment.





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## 4.5 Analysis of different industries

SNK test was conducted on the "purchase preference for new energy hybrid electric vehicles" of consumers in different industries and the four variable dimensions that affect the purchase preference for new energy hybrid electric vehicles (Table 10). The results show that.

(1) Consumers in various industries differ the most in terms of "cognitive preference for new energy hybrid electric vehicles," with consumers in the traditional energy industry having the least cognitive preference for new energy hybrid electric vehicles. The industry has a significant influence on "cognitive preference for new energy hybrid electric vehicles," as shown in Table 10. The highest group's mean value of "cognitive preference for new energy hybrid electric vehicles" is 1495.24% higher than that of the lowest group, and the variance between groups is 46.884. Consumers with different incomes were divided into three groups based on the SNK test results conducted by SPSS 26.0: traditional energy, new energy, and construction industry as one group, agriculture, forestry, husbandry, and fishery industry as a separate group, and other industries as one group. Consumers in the traditional energy industry have the lowest cognitive preference for new energy hybrid electric vehicles, indicating that more promotion and publicity of new energy types and new energy vehicle types, as well as attention to the transformation between traditional energy and new energy, is still required.
(2) Consumers from various industries have little difference in "cognition of new energy hybrid electric vehicles" (except new energy industry group). Table 10 shows that, except for the new energy industry group, there is no significant difference in perception of new energy hybrid electric vehicles across industries. The average value of "cognition of new energy hybrid electric vehicles" of the new energy industry group is higher, at 3.38, and the level of understanding of subsidy policies and technologies of new energy vehicles is deeper. Consumers in other industries, on the other hand, have little influence on their perceptions of new energy hybrid electric vehicles.
(3) Consumers engaged in construction industry have the lowest level of environmental awareness, followed by those in agriculture, forestry, husbandry and fishery. In terms of environmental awareness, consumers working in the construction industry have the lowest environmental awareness, which is closely related to the construction work itself. In the process of work, a large amount of construction waste will be generated, causing serious pollution to the environment. How to address both construction and environmental protection issues and recognize green construction is worthy of the attention and reflection of the concerned departments.

## 4.6 Analysis of different genders

SNK test was conducted on the "purchase preference for new energy hybrid electric vehicles" of consumers of different genders and the four variable dimensions affecting the purchase preference for new energy hybrid electric vehicles (Table 11). The results show that,

Consumers of different genders do not have significant differences in the four aspects of "environmental awareness," "cognitive preference for new energy hybrid electric vehicles," "evaluation of the current situation of new energy hybrid electric vehicles" and "purchase preference for new energy hybrid electric vehicles." In addition to "cognitive preference for new energy hybrid electric vehicles," female consumers outperform male consumers in the other three indicators, which may be due to women being more meticulous than men, having stronger environmental awareness, higher evaluation of new energy hybrid electric vehicles, and stronger purchase intention. However, male consumers perform better than female consumers in the indicators of "cognition of new energy hybrid electric vehicles" and "cognitive preference for new energy hybrid electric vehicles." This may be because men pay more attention to novel things, and have a deeper understanding of the automobile industry and are more familiar with vehicle performance and related policy subsidies, which explains why the average value of "cognition of new energy hybrid electric vehicles" and "cognitive preference for new energy hybrid electric vehicles" of male consumers is higher than that of female consumers.

# 5 The moderating effect of government policy perception on the purchase preference for new energy hybrid electric vehicles

As rational consumers, "the purchase preference for energy hybrid electric vehicles" is influenced by their own "environmental awareness," "cognition of new energy hybrid electric vehicles," "cognitive preference for new energy hybrid electric vehicles," "evaluation of the *status quo* of new energy hybrid electric vehicles" and other factors. National policies that are pertinent also have some influence on the acquisition of new energy hybrid electric vehicles. The government still lacks the necessary policies and procedures to develop the new energy hybrid vehicle industry as a result of the low level of new energy hybrid car development in China at the moment. In order to examine the effects of key government policies and their implementation efficiency on "new energy hybrid electric vehicle buying behavior," this research employs regression analysis approach to study the moderating effect of policy variables on behavioral variables.

## 5.1 Design of policy variables by questionnaire

Three questions are included in the survey for this study to gauge participants' perceptions and expectations of the government's intervention policy. They are: 1) The role of the government in the formation of the buying atmosphere of new energy hybrid electric vehicles; 2) The proportion of government subsidies for new energy hybrid electric vehicles; and 3) Obstacles to the implementation of new energy hybrid electric vehicles in China. For questions (1) and (2), a value

**TABLE 11 T-test results of independent samples of different genders.**

| Item | Male | | | Female | | | t | Sig. (2-Tailed) |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std Deviation | Std Error mean | Mean | Std Deviation | Std Error mean | | |
| Environmental awareness | 3.421 | 0.607 | 0.042 | 3.488 | 0.571 | 0.044 | −1.100 | 0.272 |
| Cognition of new energy hybrid electric vehicles | 2.806 | 0.716 | 0.050 | 2.615 | 0.670 | 0.051 | 2.664 | 0.008 |
| Cognitive preference for new energy hybrid electric vehicles | 2.301 | 1.747 | 0.121 | 2.288 | 1.618 | 0.124 | 0.076 | 0.940 |
| Evaluation of the *status quo* of new energy hybrid electric vehicles | 2.134 | 0.799 | 0.055 | 2.149 | 0.068 | 0.886 | −0.174 | 0.862 |
| The purchase preference for new energy hybrid electric vehicles | 2.833 | 0.755 | 0.052 | 2.860 | 0.734 | 0.056 | −0.316 | 0.752 |

Data source: The author obtained the data based on the statistical analysis of sample data from questionnaire survey and situational experiment.

**TABLE 12 Regression analysis of consumers' perception of the regulatory role of the government's new energy vehicle policy.**

| Variable | The purchase preference for new energy hybrid electric vehicles | | |
|---|---|---|---|
| | M1 | M2 | M3 |
| | β1 | β2 | β3 |
| Step 1 (Control variables) | | | |
| Region | 0.045 | −0.076 | 0.007 |
| Age | −0.094 | −0.128 | −0.072 |
| Gender | 0.051 | −0.005 | 0.013 |
| Education | 0.048 | 0.108 | 0.080 |
| Monthly income | 0.156 | 0.027 | 0.104 |
| Industry | 0.056 | −0.042 | 0.111 |
| The adjusted $R^2$ | 0.027 | | |
| F | 2.720 | | |
| Step 2 (Main effect) | | | |
| Cognitive | | 0.420 | 0.401 |
| Policy | | −0.019 | 0.012 |
| The adjusted $R^2$ | | 0.192 | |
| ▲$R^2$ | | 0.167 | |
| F | | 12.239 | |
| Step 3 (Regulating effect) | | | |
| Perception × Policy | | | −0.040 |
| The adjusted $R^2$ | | | 0.190 |
| ▲$R^2$ | | | 0.000 |
| F | | | 10.850 |

Data source: The author obtained the data based on the statistical analysis of sample data from questionnaire survey and situational experiment.

of "1"denotes a very low level of government participation, while a value of "5"denotes a high level of government participation. Question (3) is a multiple-choice question, and the research group assigns values according to the number of correct answers chosen by the respondents. These three questions were answered as part of a questionnaire by the experimenters. After analyzing the data from the questionnaire, the factor analysis revealed that there was no link between the policy variable and the other 15 factors, allowing it to be utilized as a moderating variable.

## 5.2 Verification of the adjustment effect of policy variables

First, average and standardize the sum of the scores of the three questions (independent variable), average and standardize the sum of the scores of "purchase preference for new energy hybrid electric vehicles" index (dependent variable), average and standardize the sum of the scores of "cognition of new energy hybrid electric vehicles"; Then, the standardized score of consumers' perception of the government's new energy vehicle policy and its

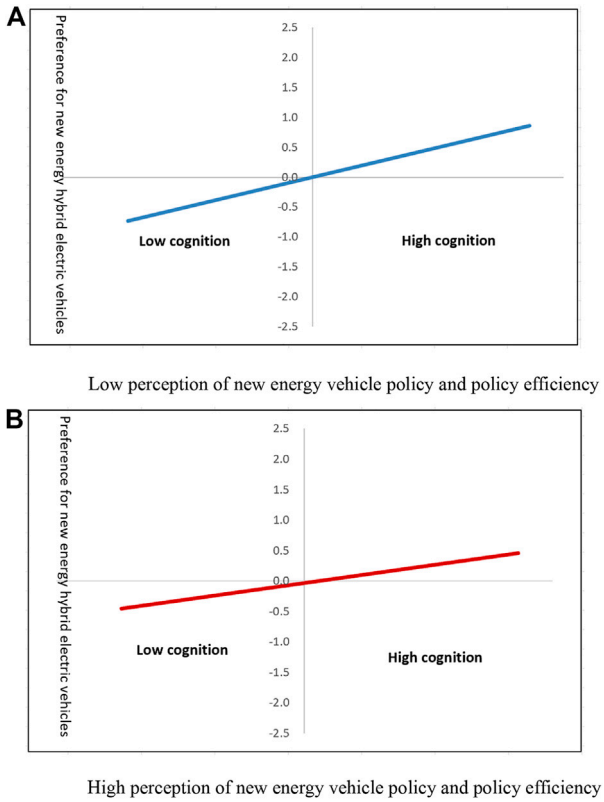


FIGURE 7
Schematic diagram of the moderating effect of consumers' perception of low-carbon policies and the efficiency of policy implementation.

implementation efficiency is multiplied by the average value of the standardized "cognition of new energy hybrid electric vehicles." Finally, regression analysis was performed (Table 12). It can be seen from Table 12 that consumers' "perception of the government's new energy vehicle policy and its implementation efficiency" has a significant moderating effect between "cognition of new energy hybrid electric vehicles" and "purchase preference for new energy hybrid electric vehicles", that is, the more standardized the government's new energy vehicle policy, the stronger the "purchase preference for new energy hybrid electric vehicles".

In order to more clearly describe the regulating effect of policy intensity on "purchase preference for new energy hybrid electric vehicles", the method proposed by Aiken et al. (1991) was adopted in this paper. Depending on the mean value of policy intensity, one standard deviation was added or subtracted to the original data, and the original samples were converted into high policy intensity and low policy intensity. And do the regression equation of "cognition of new energy hybrid electric vehicles" and "purchase preference for new energy hybrid electric vehicles" respectively. Figure 7 show that no matter the policy intensity is high or low, the correlation coefficient between "cognition of new energy hybrid electric vehicles" and "purchase preference for new energy hybrid electric vehicles" is significant: β high policy = 0.437, $p < 0.05$; β low policy = 0.455, $p < 0.05$. There is no significant difference in the correlation coefficient between low and high policy intensity, indicating that consumers are unconcerned about the government's new energy mixed policy and its implementation efficiency, resulting in a small difference between policy intensity and purchase preference.

# 6 Conclusions and recommendations

## 6.1 Research conclusions

Through the above analysis and research, we reach the following conclusions.

(1) There is a significant disparity in "cognitive preference for new energy hybrid electric vehicles" among different categories of consumers. The relative difference of "cognitive preference for new energy hybrid electric vehicles" in different demographics is listed as industry, age, educational level and monthly income from highest to lowest. Industry is the largest within group variance of each demographic variable, followed by monthly income, age and educational background. ①The gap characteristics of "cognitive preference for new energy hybrid electric vehicles" of consumers in various demographic variables show that the high income, high education, adolescent (under 19 years old) male consumer groups in economically developed areas and engaged in new energy-related industries have a strong cognitive preference for new energy hybrid electric vehicles. ②The gap between industries in "cognitive preference for new energy hybrid electric vehicles" is the largest, which indicates that industry correlation has a more obvious role in improving "cognitive preference for new energy hybrid electric vehicles." "Environmental awareness," "cognition of new energy hybrid electric vehicles," "evaluation of the current situation of new energy hybrid electric vehicles" and "purchase preference for new energy hybrid electric vehicles" are also the largest among the variables in the inter-industry gap, especially "evaluation of the current situation of new energy hybrid electric vehicles." ③The difference value of consumers' "cognitive preference for new energy hybrid electric vehicles" in each variable is the largest, indicating that each variable has a significant effect on "cognitive preference for new energy hybrid electric vehicles".

(2) There is little variation difference in "purchase preference for new energy hybrid electric vehicles" among different categories of consumers. The relative difference of "purchase preference for new energy hybrid electric vehicles" in different demographics is ranked as industry, age, educational level and monthly income from highest to lowest, which is consistent with the ranking of "cognitive preference for new energy hybrid electric vehicles." The differences in consumers' "purchase preference for new energy hybrid electric vehicles" in various demographic variables show that the high-income, highly educated, middle-aged and young (30–39) female consumer groups in economically developed areas and engaged in new energy-related industries have strong purchase preference for new energy hybrid electric vehicles.

(3) The "environmental awareness" of consumers deserves attention. According to the analysis of different regions, there is little difference in environmental awareness between sub-provincial and prefectural levels. The analysis of different age groups displays that teenagers have the lowest environmental awareness; The analysis of different educational background and income reflects that the improvement of educational background and income plays a significant role in promoting the "environmental awareness" of consumers; The analysis of different industries indicates that consumers engaged in processing and manufacturing related industries have low environmental awareness; The gender-specific analysis illustrates that women are more environmentally conscious than men.
(4) Consumers' "purchase preference for new energy hybrid electric vehicles" is affected by their perception of the government's new energy vehicle policies, but the degree to which these policies are implemented does not significantly alter this preference. According to the empirical analysis, consumers' "preference for new energy hybrid vehicles" will be stronger the more they believe the government plays a role in influencing the market for new energy hybrid vehicles, the higher the percentage of government subsidies, and the fewer obstacles to their adoption are. The government should concentrate on integrating the policy's content into residents' lives while vigorously implementing the policy in order to achieve the expansion of promotion efforts and put the policy in place as the implementation effect of the new energy vehicle policy of high and low intensity is not significant.

## 6.2 Policy suggestions

Based on the above research conclusions, this paper puts forward the following policy recommendations.

(1) Subdivide the consumption market for new energy hybrid electric vehicles and tap key customer groups for these vehicles. It is suggested to take high-income, highly educated, middle-aged and young female consumers (30–39 years old) in economically developed regions as the breakthrough point to spearhead the consumption strategy of new energy hybrid electric vehicle products. According to the differences in "purchase preference for new energy hybrid electric vehicles" among consumers in different regions, with different degrees, different ages, different incomes, and different occupations, different promotion strategies for new energy hybrid electric vehicles are formulated to stimulate the demand of various consumer groups for new energy hybrid electric vehicles.
(2) Increase the publicity and education about new energy hybrid electric vehicles and improve the environmental awareness of new energy hybrid electric vehicles among all groups of consumers. It can be seen from the above analysis results that consumers who are engaged in processing and manufacturing-related industries, are aged 20–29 years old, and live in economically developed areas have the lowest environmental awareness. The relevant government departments in China should carry out specific knowledge training and education for this group of people and take necessary assessment measures to improve consumers' overall environmental awareness and awareness of new energy hybrid vehicles.
(3) Attach importance to the guidance of new-energy hybrid electric vehicle consumption and improve consumers' cognition and preference for new-energy hybrid electric vehicle products. Publicize the new energy hybrid vehicle products through various media, such as television, the internet, community newspapers, posters, etc., and establish the leadership, organization, and publicity mechanisms for the consumption education and guidance of new energy hybrid vehicles, as well as guide the consumption behavior of new energy hybrid vehicles through various channels of government, enterprises, and consumers, in order to increase public awareness and preference for new energy hybrid vehicle products, and furthermore to lay a theoretical foundation for the possible purchase behavior in the later stage.
(4) Improve policies related to new-energy hybrid electric vehicles and improve the efficiency of their implementation. New energy hybrid vehicle consumption policies include financial (price) subsidies given by the government, the government's promotion of new energy hybrid vehicle products and promotional measures, the government's efforts to develop new energy hybrid vehicle-related systems, and other specific government policies to promote new energy hybrid vehicle consumption. In addition to the formulation of government policies, the efficiency of policy implementation at all levels of government also needs to be improved, through the establishment of a compensation mechanism for the development of new energy hybrid vehicles and the encouragement of local governments to develop new energy hybrid vehicle development plans with "local characteristics", so that consumers can better perceive the degree of government attention and implementation efficiency and, thus, improve their enthusiasm to participate in the consumption of new energy hybrid vehicles.
(5) Enrich the subsidies for the purchase of new energy hybrid electric vehicles and increase the preferential efforts for new energy hybrid electric vehicles. The larger the government subsidy, the cheaper the initial purchase cost for customers, and the higher their buying preference. In other words, the more the government can influence people's behavior through preference and the more ways it can do so, the more it can influence people's behavior. Currently, the state only provides subsidies in the form of cash and does so exclusively using money obtained from the sale of private cars. The use of new energy hybrid vehicles in production, sales, and use, as well as a combination of taxes, plans, policies, and other methods to encourage and promote the development of new energy hybrid vehicles, are all possible measures the government can take to promote the development of new energy hybrid vehicles.

# Data availability statement

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

# Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not

required to participate in this study in accordance with the national legislation and the institutional requirements.

## Author contributions

Conceptualization, QG; Methodology, QG; Software and formal analysis, YL and LC; Writing—original draft preparation, QG, YL, and LC; Writing—review and editing, QG, YL, and LC; Supervision and funding acquisition, QG. All authors have read and agreed to the published version of the manuscript.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# Examining green purchasing. The role of environmental concerns, perceptions on climate change, preferences for EU integration, and media exposure

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Factors impacting green consumption studied in the literature include 1) economic incentives and possibilities, 2) socio-dem1ographic segmentation, 3) values, emotions and personal responsibilities, 4) information including education and mass media, 5) factors related to the locality of the respondents and the lifestyles. While the effects of environmental concerns and perceptions of climate change or green purchasing are well established, the impacts of preferences for EU integration and media exposure are less clear. The article examines the effects of environmental concerns, perceptions of climate change, trust in EU policies, and media exposition on green purchasing employing a representative sample of 904 respondents (aged 15–95 years, M ± SD: 47.74 ± 17.66; 51.40% women, 19.40% with higher education) in the Czech Republic. Methodologically we rely on principal component analysis, correlations, and a set of ordinal regression analyses. The results suggest that 1) the public perceives the agendas of environment protection and climate change as two different agendas. 2) environment protection attitudes and climate concerns, the acceptance of EU integration positively predict green consumption. 3) the impact of the media exposition proved controversial: printed media and online discussion forums and blogs positively predicted green purchasing, while exposition to online social networks negatively impacted purchasing of organic food; 4) the frequency of watching TV negatively predicted purchasing of environmentally friendly products. We suggest that the advertisements emphasizing low prices may reduce willingness to pay a price premium for green products. It implies that more efforts need to be made on TV and social networks to increase public awareness of green consumption.

KEYWORDS

**environment, consumption, organic food, local food, EU, politics, public perceptions, climate change**

## 1 Introduction

Green purchasing is an important part of environmental sustainability and responsible stewardship of resources. It involves the acquisition of goods and services that are environmentally friendly and reduces the negative impacts of production, use and disposal. Green purchasing can help reduce environmental pollution, conserve natural

resources, reduce energy and water use, reduce waste and reduce the environmental costs of production, transportation, and disposal.

Factors affecting green consumption have been a long subject of research. The early literature on green consumption presented the term in the context of "societal marketing," which addressed environmental questions (Fisk, 1974; Henion and Kinnear, 1976) and studied economic incentives and socio-demographic segmentation. Later on, individual values, emotions and attitudes proved to be more important. Environmental attitudes, knowledge and personal responsibilities showed to have positive effects on green consumption in some cases but not in others. Dominant social paradigms (e.g., consumerism), individual and collective norms, and habits, such as the perception that green products are luxuriously expensive and insufficient or incorrect information, may reduce green consumption.

All these factors are affected by the agenda presented in the mass media and discussion platforms, which may, if effective, create group norms and affect intentions and actual behavior (Moore and Moschis, 1983; Willnat and Weaver, 2018; Chen et al., 2019).

In Europe, green consumption is a subject of a number of political initiatives on the level of the EU and single countries. The EU is considered a global leader in environmental and climate change politics (Skovgaard, 2014; Fischer and Geden, 2015); green procurement is an essential part of public and private consumption policies (Calabro, 2007). These initiatives are not always accepted positively by the local population, which may affect the willingness to purchase green products. In the Czech Republic, environmentally charged EU policies traditionally evoke controversy, as they negatively affect coal-producing regions, limit the supply of cheap but environmentally damaging products, and incorporate environmental externalities into the product prices. The EU Environmental policies damaged the economies of the poor coal-producing regions and created an aversion in part of the population to EU integration (Cabelkova et al., 2020; 2022).

Environment protection requires relevant knowledge transferred to the general public through school education or various types of mass media (traditional, online, social). In this field, research on the media's role in different sustainable actions is still largely missing (Chen et al., 2019).

This paper aims to study the role of environmental attitudes, perceptions on climate change, attitudes to the EU, and media exposure in predicting environmentally responsible consumption in the Czech Republic. We distinguish three types of "green" commodities: organic food, local food, and environmentally friendly products. Methodologically we rely on Principal Component Analysis (PCA), correlation, and ordinal regression analyses applied to a representative sample of 904 respondents (aged 15–95 years, M ± SD: 47.74 ± 17.66; 51.40% women, 19.40% with higher education) in the Czech Republic to reach the following research objectives:

1. The literature suggests that environmental concerns and attitudes may increase green purchases. However, the effect does not always manifest itself as economic and normative factors may play a bigger role. For example, green products may be considered luxuriously expensive, and the norm is not to buy them. The paper aims statistically examine the effect of environmental concerns and attitudes on green purchasing.
2. One of the more recent environmental concerns relates to climate change. While in general, it presents a sub-set of environmental changes, it is often communicated as a separate category. This paper aims to study 1) whether the concerns about climate change are disconnected from environmental concerns in the minds of the representative sample (via factor analysis) or belong to the same factor. 2) The paper aims to test the relation between the concerns with climate change and green purchasing.
3. Enhancing green consumption is one of the priorities of the European Union, manifested in several legislative documents and overall communication. However, the green agenda produces certain controversies, especially in the coal-producing regions, and may not always be viewed positively. This paper aims to test whether the acceptance of EU integration positively predicts green purchasing
4. Mass media is one of the important factors affecting the level of information, but also the group norms and attitudes. Ideally, we suggest that mass media positively affect green consumption. This paper aims to test whether the exposition to mass media (TV, printed media, online news social networks, online discussions and blogs, social networks, and offline discussions) is related to green purchasing and if yes, whether this is a positive or negative association.

The paper is structured as follows. The first section briefly reviews the literature on green purchasing and provides the literature review on the factors affecting green consumption. The following sections discuss the role of preferences for environment protection, climate change, EU policies, and the mass media related to green purchasing and the relevant agendas in European contexts. Then, we describe the model, data, and methods. The results, discussion and conclusions close the paper.

## 2 Green purchasing

Green purchasing (GP) refers to 1) purchasing environmentally friendly products, which are usually recycled and bring benefits to the environment, and 2) avoiding products that harm the environment (Chan, 2001; Mostafa, 2007; Steg and Vlek, 2009). In this regard, GP should be distinguished from sustainable purchasing, which, besides environmental sustainability, accounts for economic, social, health, and other sustainability aspects (Miemczyk et al., 2012).

While the definition of green products is relatively simple in practice, there is still a certain controversy about which products can be classified as green (Huijbregts et al., 2008; Hanafiah et al., 2012; Mancini et al., 2016) since many environmental externalities cannot be directly measured. Nevertheless, green marketing utilizes the green phenomenon to propagate some products as "green" via various "green" certificates and labels (Boström and Klintman, 2008; Schwartz et al., 2020). Besides the products themselves, a number of certificates and labels are employed to indicate the use of eco-friendly or recycled materials in production or packaging, sustainable agrarian practices, or responsible animal handling (eco-labeling, Dhir et al., 2021; Anuar et al., 2020).

Though green- and eco-labeling and environmental concerns are on the rise, the actual purchase of green products still falls behind (Rizqiyana and Wahyono, 2020; Wojnarowska et al., 2021). The intention to purchase green often is not followed by the action.

Hughner et al. (2007) showed that though 67% of consumers reported a positive attitude to organic food products, only 4% purchased those products. The discrepancy between the positive attitude and actual green purchases is widely reported in the literature as ["green purchasing inconsistency" or "green attitude-behavior gap" (Joshi and Rahman, 2015; Wang et al., 2019a; Witek, 2019)]. The following section presents the factors affecting green consumption and green purchasing *per se*.

## 3 The factors affecting green purchasing. Literature review

Green purchasing belongs to a more general category of green consumption. The concept of green consumption first emerged in the 1970s in the United States, alongside the development of "societal marketing," which addressed environmental questions. Fisk's Theory of Responsible Consumption (Fisk, 1974), Henion and Kinnear's Ecological Marketing (Henion and Kinnear, 1976), and Kardash's Ecologically Concerned Consumer (Kardash, 1974) all contributed to categorizing green consumption. Initially, research focused on energy use, pollution connected to the automobile, oil, and chemical industries, as well as consumer reactions to advertising and labeling (Henion and Kinnear, 1976; Kilbourne and Beckmann, 1998; Peattie, 2010). Later, the studies concentrated more on green purchases of food products and environmentally friendly products.

The literature on factors affecting green consumption aimed at defining factors that might help to increase green consumption. Obviously, the factors in question reflected the dominant social and economic paradigms of a particular period and social context. The early literature concentrated on economic incentives and financial possibilities of households, socio-demographic characteristics, and environmental knowledge (Peattie, 2010). The proponents of economic rationality viewed green consumption as primarily affected by economic factors and suggested that government policy must provide primarily economic incentives (Bartelings and Sterner, 1999; Eriksson, 2004; Jackson, 2005; Wang et al., 2021; Shen and Wang, 2022). This approach is still used, for example, in waste management, where the households are incentivized to sort communal waste by making the disposal of sorted waste free of change. The economic literature also suggests that more affluent households produce a larger environmental footprint but can afford to purchase "greener" goods (Cymru, 2002; Lenzen and Murray, 2003; Huang, et al., 2022). Thus, income rise may increase green consumption.

Socio-demographic aspects as predictors of green consumption were originally important primarily from the point of view of market segmentation according to sex, age, presence and number of children, educational level, and socioeconomic class (Laroche, et al. (2001); Robinson and Smith (2002); Jenkins, et al. (2003). Yet, they are still frequently included in empirical analyses, often as control variables (Walia et al., 2020)

The impact of environmental knowledge in supporting green consumption is not uniform. The straightforward conclusion that providing more information about the environment increases green consumption was supported by some studies (Bartkus et al., 1999) but not the others (Davies, et al., 2002; Pedersen and Neergaard, 2006; Rustam, et al., 2020). Besides price ("green" goods are still more expensive, making them difficult to afford), the green attitude-behavior gap seems to play a role here (Joshi and Rahman, 2015; Wang et al., 2019b; Witek, 2019).

While the early studies studied primarily economic, demographic, or knowledge factors, the later research proved that attitudes and values are often more important predictors of green consumption than rational choices. (Han, et al., 2007; Carrus et al., 2008; Peattie, 2010; Wang, et al., 2019a). The values are a broad category. One stream of research concentrated on the existing models of values. For example, Schwartz's value model or altruist values were shown to be related to pro-environmental behavior. However, other studies report the opposite—pro-environmental values increase product reuse and waste-minimization intentions and behaviors but not recycling (Barr, 2007), or pro-environmental values increase the intention to recycle and conserve water but not to buy organic food or avoid leaving appliances on standby (Lyndhurst, 2004). The other studies report that environmental attitudes, environmental knowledge, subjective norms, perceived behavioral control, conditional value, and emotional value have a positive effect on green purchase intentions (Nekmahmud, et al., 2022a)

The lower expected effect of pro-environmental values on pro-environmental behavior was explained by the particularities playing more important role (Barr, 2007) or by the impact of economic incentives (Bartelings and Sterner, 1999; Eriksson, 2004; Jackson, 2005; Wang et al., 2021; Shen and Wang, 2022) and the green attitude-behavior gap (Joshi and Rahman, 2015; Wang et al., 2019a; Witek, 2019). The dominant social paradigm (DSP) and cultural/ethnic group norms may reduce the role of the value factors above (Kilbourne, et al., 2002; Johnson et al., 2004; Halder, et al., 2020; Fischer, et al., 2021). For example, consumerism reduces willingness to engage in green consumption (Kilbourne and Polonsky, 2005; Fischer, et al., 2021). Consumption is then viewed as a social process in social, political, and historical contexts, and conditions of lives and lifestyles bear immense importance. All these factors affect green consumption (Connolly and Prothero, 2003; Moisander, 2007; Beatson, et al., 2020; Fischer, et al., 2021). The (pro) environmental behavior may also belong to social norms. For example, recycling may be adopted because it is perceived as normal, Barr (2007), or the existing prices may represent the norm, and greener products represent an expensive luxury (Krystallis and Chryssohoidis, 2005). Similarly, pro-social behavior is showed to influence pro-environmental behavior (Ramkissoon, 2023).

Values can be effective in the case the consumer feels that a change in his behavior can produce a significant change in the environmental outcome, or, oppositely, the current state of the environment is partly caused by his behavior. Understanding personal responsibilities for both causing and solving environmental problems and believing that the action they take can have a meaningful impact was shown to be a significant predictor of pro-environmental behavior (Gupta and Ogden 2009; Yue et al. (2020).

The spatial dimension (local, urban/rural, regional, and national) is the next dimension of factors affecting pro-environmental behavior (Peattie, 2010). The urban and rural differ in waste infrastructure (Munksgaard, et al., 2000), style of housing, agricultural systems, and specific mix of energy sources (Hines and Peattie, 2006), and people's behavior (Tang, et al., 2022). We can expect different economic incentives in pro-environmental behavior, different local culture and style of life and habits

(Empacher and Götz, 2004; Leiserowitz, et al., 2010; Vita, et al., 2019; ElHaffar, et al., 2020; Samkange et al., 2021).

All the perceptions, values and knowledge can be impacted by the mass-media and education. The impact of mass media on pro-environmental values and pro-environmental behavior was shown to be a significant one (Haron et al., 2005; Jain, et al., 2020; Wagdi, et al., 2022). Especially video content that is largely based on emotions has a particular influence on pro-environmental attitudes (Ramkissoon, and Smith, 2014). Social media, as a special case of the mass media, were shown to have a significant positive effect on green consumption intentions promoting attitude, subjective norms, and green thinking via social media marketing (Nekmahmud, et al., 2022b). However, the media is such a complex phenomenon that much of the research on the media's role in different sustainable actions is still largely missing (Chen et al., 2019).

This paper contributes to the research on the factors affecting green consumption by studying the effect of values and attitudes related to climate change, environment protection, personal possibility to affect environmental outcomes such as climate change, and the sufficiency of information about environmental protection. We add political attitudes such as trust in the European Union and the perceived reasonability of EU integration. In addition, we add more comprehensive research on the effect of media exposure (TV, printed media, radio, internet news, discussions and blogs, social networks, and offline discussions), socio-demographic indicators including sex, gender, education, the standard of living, and town size. The following sections will describe more closely relevant agendas and the existing literature.

# 4 The factors affecting green consumption studied in this paper. The relevant agendas and literature and hypothesis development

## 4.1 The agenda of climate change

The climate change agenda is largely related to global warming production, among other extreme weather events. However, personal experience with extreme weather phenomena such as hurricanes and storms is rare, and overall observable temperature increase is not always associated with global warming. Thus, the information about climate change largely depends on the mass-media presentation (Anderson, 2011; Ryghaug et al., 2011), though the scope and frequency of presentation of climate-related agenda in different countries fluctuate (Schmidt et al., 2013). In the extreme case, public opinion can be understood as just a simple reflection of the extent and prominence of media coverage (the agenda-setting hypothesis, McCombs and Valenzuela, 2020; Dumitrescu and Mughan, 2010; the quantity coverage theory; Mazur, 2009).

The agenda of climate change, as presented in media, suffered considerable changes with the change of the media itself. The diminishing role of specialist reporters and the emergence of online news media and niche sites specializing in climate journalism accompanied by the shift of roles of journalism from "gatekeeping" to "curating" roles plus the change of journalist sources from elite scientists to a broader range of stakeholders led to a strong and rising influence of the interests of stakeholders to climate journalism (Schäfer and Painter, 2021). The engagement of stakeholders presenting their interests in the media led to overrepresentation of climate change issues compared to the general agenda of environment protection (Legagneux et al., 2018).

The media agenda formation is shown to produce significant polarization of the climate-related agenda (Li, et al., 2013; Matakos, et al., 2017; Gubanov and Petrov, 2019). Facing perceived scientific uncertainty about climate change, the media norms eventually helped the climate-skeptic opinions to become a relevant part of the climate discourse. The internet-based social networks can exacerbate the effect of opinion polarization. The pre-defined computer algorithms are likely to diminish the exposure frequency of the content, presenting alternative ideas (Pearce et al., 2019).

Social networks, open forums, and internet-based discussion platforms are the other frequent source of climate change attitudes (Williams et al., 2015; Pearce et al., 2019), where all kinds of influencers and celebrities can shape public opinion (ibid., Anderson, 2011)

In the Czech Republic, the discussion on climate change in mass media is rather scarce in most cases, presented according to the mainstream viewpoint as global warming of anthropogenic origin (Trunečková, 2015; Navrátilová, 2021; Cabelkova et al., 2022). The appeal to fight climate change via the adoption of climate-conscious behavioral patterns was also dominant (ibid.). On the other hand, in the context of economically important areas (such as coal mining), the climate effects of fossil fuels were effectively missing (Lehotský et al., 2019; Černý and Ocelík, 2020; Cabelkova et al., 2022).

In any case, the methods to fight climate change are presented primarily as the reduction of greenhouse gas emissions via green consumption, green housing, and green travel (Alfredsson, 2004).

From the discussion above and in line with literature survey two hypotheses can be made:

**Hypothesis 1:** Concerns with climate change positively predict green consumption.

**Hypothesis 2:** The impact of the media on green consumption may vary according to the type of the media as some types produce significant polarization of opinions.

## 4.2 The agenda of environmental protection

Though measures combatting climate change is one of the forms of environmental protection, the media presentations of the two substantially differ. While the dangers of climate change are often distant and not primarily visible in the Czech Republic, environmental degradation is more often experienced already (Hůnová, 2020). The health effects of contaminated food, smog, frequently appearing in the cities, and changes in biodiversity in ecosystems are experienced directly. In the Czech Republic, the agenda and environmental effects of coal mining and processing are directly visible to the general public in exposed regions (Lehotský and Černík, 2019).

So, contrary to climate change agenda, general environment protection attitudes are more related to personal experience (positive or negative) and less affected by the media. If fact, the agenda of environment protection might be perceived as a completely different agenda from the agenda of climate change. Thus we can formulate the following research question:

Q1. Values related to climate change and environment protection represent two separate sets of values belonging to two factors.

We do not formulate this as hypotheses since it is not directly testable, though we will apply exploratory factor analysis to research it.

**Hypothesis 3:** The concerns with environment protection positively predict green consumption.

### 4.3 The role of preferences for EU integration. The specifics of the Czech Republic

The EU policies that are relevant to consumers' sustainable choices can be divided into two categories: product legislation and waste legislation. Product legislation includes environmental product requirements, information and labeling requirements, rules on product guarantees, and climate legislation (Sajn, 2020). Waste legislation makes it easier to waste recycling. Though in general, these policies are beneficial for the environment, in the Czech Republic they aroused certain controversy, as they affected the economic choices of coal-producing regions, limited the supply of cheap but environmentally damaging products, and in general, incorporated the environmental externalities into the product prices (Cabelkova et al., 2020; 2022). Thus, the trust in the EU and the public attitudes to environmental and economic EU policies were compromised in affected regions.

Being as it is, we hypothesize, that:

**Hypothesis 4:** Positive attitudes to European integration and policies with respect to environment and economic development positively predict green consumption.

### 4.4 The role of the media

Media play an essential role in disseminating information, thus influencing people's knowledge, awareness, attitudes, and socioeconomic choices (Madajewicz et al., 2007; Jalan & Somanathan, 2008). Media usage and browsing significantly affect sustainable purchasing (Zafar, et al., 2021). The impact of the media on environmentally responsible attitudes and behaviors varies according to the type of media and the agenda the media presents (Cabelkova et al., 2020; 2022).

We hypothesize that:

**Hypothesis 5:** Exposition to the mass media predicts green consumption. The type of the association depends on the media.

## 5 Materials and method

### 5.1 The model

The model is built according to the principles of the general behavioral change model (Hungerford and Volk, 1990; Boudreau, 2010) applied to environmentally responsible behavior (Figure 1).

The knowledge part is impacted by the education level and the sources of information about the social life. Awareness and attitudes are then represented by the awareness and concerns with the environment and climate change, satisfaction with the current state, and sufficient information about environmental protection. As environmental protection was one of the topics that proliferated on the level of EU policies, we include the indicators of trust and attitude to EU policies. Finally, we also control for socio-demographic variables. The resulting model and hypotheses are presented in Figure 2.

### 5.2 The data

The data were collected in July 2021 via a survey entitled Our society (Naše společnost) conducted by the Czech Institute of Sociology. A total of 904 respondents (aged 15–95 years, M ± SD: 47.74 ± 17.66; 51.40% women, 19.40% with higher education) answered the questions in the questionnaire voluntarily and anonymously under the supervision of 139 experienced interviewers. Methodologically the method of interviewing can be classified as structured interviews. As the quality of the filled-out questionnaires was considered very good, all the questionnaires were included in the data sample. All participants were Czech native speakers living in the Czech Republic. The method of sampling relied on representative sampling with quotes. The quotes included the geographical position, age, gender, and education of the respondents. According to quotes, the data sample is representative of the Czech Republic. The data were kindly provided by the Czech Social Science Data Archive (Sociologický ústav., Akademie věd ČR. 2021).

### 5.3 The indicators

#### 5.3.1 Green purchasing

The indicators of green purchasing include the frequency of purchasing organic food, local food, and environmentally friendly products. The exact wording of the questions and the distribution of the respondents are presented in Table 1.

The least frequent green purchasing is reported in the cases of buying organic food (22.30% report buying it always or often, and 28.40% of the respondents report never buying them). On the other side, the Czech population showed to be environmentally conscious in purchasing locally produced food, where 58.20% of the respondents reported buying it always or often (Table 1).

#### 5.3.2 Perceptions on the environment, climate change, attitude to EU policies

The exact wording of the questions and the distribution of the respondents are presented in Table 2.

The majority of the respondents perceive environmental protection as urgent or rather urgent (78.3%), although most of the respondents are very or rather satisfied with the state of the environment in their neighborhood (75.9%, Table 2). Approximately half of the respondents are worried or rather worried about climate change (53.9%), and are rather optimistic about the ability of people to affect climate change if they change their current behavior (69.2%, Table 2).

However, society is polarized regarding the environmental and economic effects of European integration and trust in the European Union. Approximately a third of the respondents (33.8% in

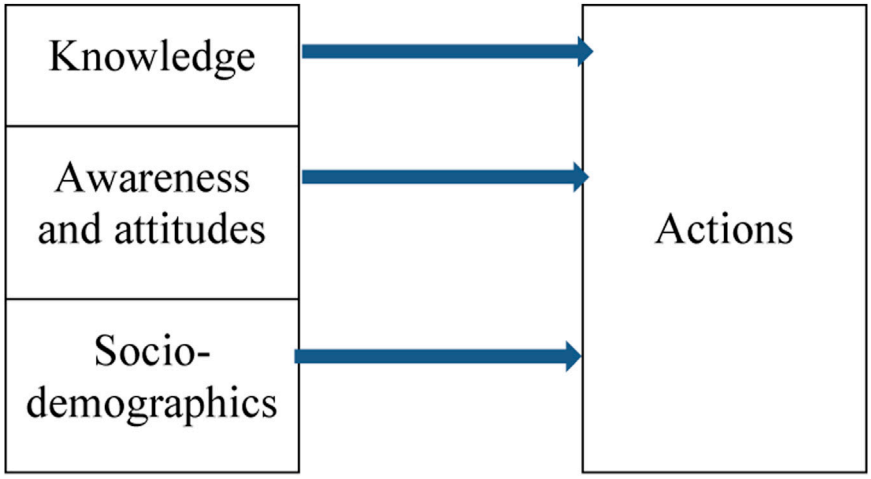


FIGURE 1
Behavioural change model. Source: modified from Boudreau, 2010; Hungerford and Volk, 1990.

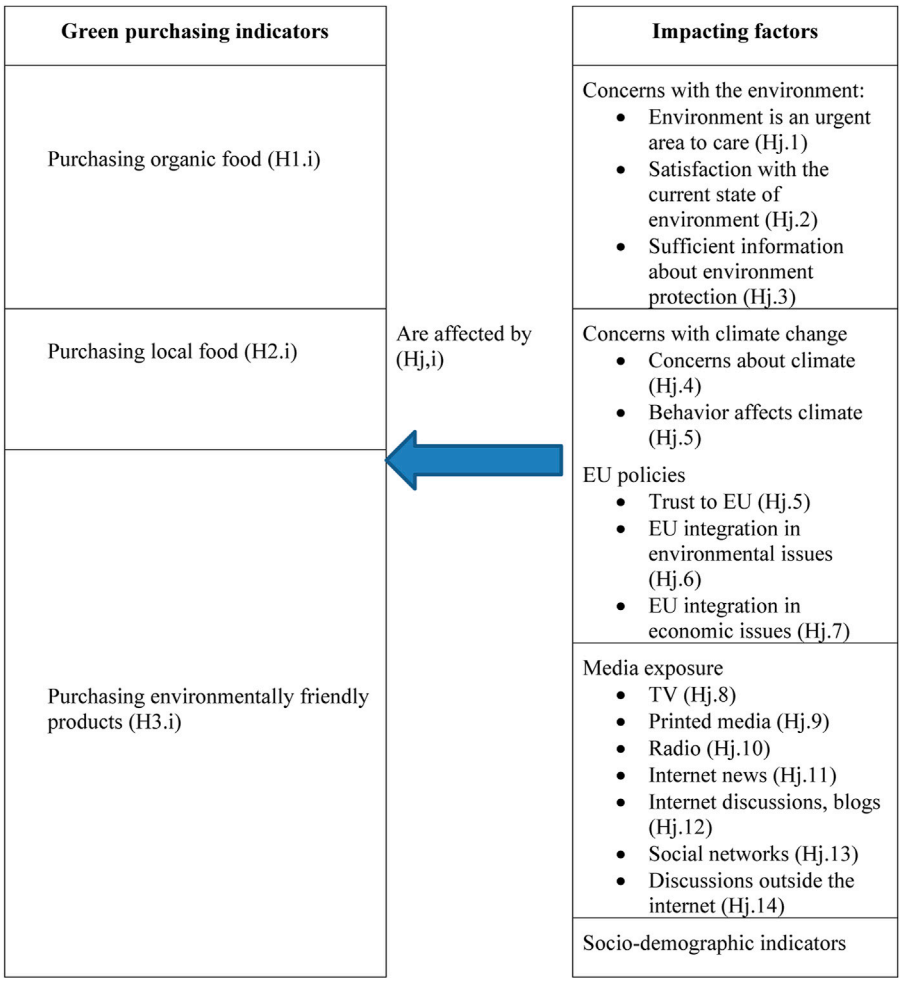


FIGURE 2
The model and hypotheses (Hj.i). Scholars have highlighted that lack of information might prevent consumers from buying sustainable products as it impacts individuals at multiple psychological levels (Cerri et al., 2018; Testa et al., 2015).

**TABLE 1 Environmental consumption indicators. The exact wording of the questions and the distribution of the respondents (%).**

| As far as your household is concerned, you | Always | Often | Rarely | Never | N/A |
|---|---|---|---|---|---|
| Purchasing decisions | | | | | |
| - buy organic food | 3.10 | 19.20 | 45.00 | 28.40 | 4.30 |
| - buy locally-produced food | 8.10 | 50.10 | 30.10 | 7.50 | 4.20 |
| - when buying products, you are guided by whether they are environmentally friendly | 7.00 | 23.80 | 32.20 | 26.80 | 10.20 |

Source: own computations based on representative raw data from Sociologický ústav. Akademie věd ČR. (2021).

**TABLE 2 Perceptions on the environment, climate change, EU. The distribution of the respondents (%).**

| *How urgent do you think it is to address the following areas in the Czech Republic this year: Environment protection* | | | | |
|---|---|---|---|---|
| Not urgent at all | Rather urgent | Very urgent | N/A | |
| 19.8 | 48.8 | 29.5 | 1.9 | |
| *How satisfied are you with the environment in the place where you live?* | | | | |
| Very satisfied | Rather satisfied | Rather dissatisfied | Very dissatisfied | N/A |
| 19.7 | 56.2 | 18.8 | 4.6 | 0.7 |
| *Do you have enough information about how to be environmentally friendly?* | | | | |
| Definitely enough | Rather enough | Rather not enough | Definitely not enough | N/A |
| 15.3 | 52.2 | 22.9 | 4.0 | 5.6 |
| *How worried are you about the impacts of climate change?* | | | | |
| Very worried | Rather worried | Rather not worried | Not worried at all | N/A |
| 13.2 | 40.7 | 26.2 | 9.2 | 10.7 |
| *Do you think that if people changed their current behavior, they could change the current climate change?* | | | | |
| Could stop it completely | Could slow it down | Could not affect the climate change | N/A | |
| 5.9 | 63.3 | 15.0 | 15.8 | |
| *In your opinion, is European integration beneficial or harmful in these areas: economy* | | | | |
| Definitely beneficial | Rather beneficial | Rather harmful | Definitely harmful | N/A |
| 11.7 | 44.0 | 26.2 | 7.6 | 10.5 |
| *In your opinion, is European integration beneficial or harmful in these areas: environment* | | | | |
| Definitely beneficial | Rather beneficial | Rather harmful | Definitely harmful | N/A |
| 12.2 | 46.2 | 20.0 | 6.4 | 15.2 |
| *Please tell me, how much do you trust the European Union* | | | | |
| Definitely trust | Rather trust | Rather distrust | Definitely distrust | N/A |
| 5.2 | 45.5 | 27.2 | 15.4 | 6.7 |

Source: own computations based on representative raw data from Sociologický ústav Akademie věd ČR. (2021).

economic policies and 26.4% in environmental policies) believe that EU integration is harmful to the Czech Republic. 42.6% of the respondent reported some level of distrust to the EU.

### 5.3.3 Media exposure

The distribution of the respondents on media exposure and the exact wording of the questions are presented in Table 3

Most TV is still frequently used media, while the second place is occupied by radio and online news. Printed newspapers and magazines and offline discussions are relatively rarely used sources of information (Table 3). Social networks are very respondent-specific and rarely used 40.9% of the respondents never use them.

### 5.3.4 Socio-demographic characteristics

We control for the standard of living (very good 8.8%, rather good 45.7%, neither good nor bad 35.2%, rather bad 8.6%, very bad 1.2%), gender (51.4% women), age (aged 15–95 years, M ±

**TABLE 3** Media exposure. The distribution of the respondents (%).

| How often do you follow social life on | At least 1x a day, % | Several times a week, % | 1x a week, % | Less than 1x a week, % | Never, % | N/A, % |
|---|---|---|---|---|---|---|
| TV | 42.1 | 33.8 | 10.3 | 7.3 | 5.9 | 0.6 |
| Printed newspapers, magazines | 7.2 | 18.3 | 23.0 | 24.2 | 26.7 | 0.6 |
| Radio | 19.1 | 28.4 | 16.7 | 14.3 | 20.6 | 0.9 |
| Online news servers | 19.6 | 29.1 | 15.8 | 12.9 | 22.0 | 0.6 |
| Social networks | 14.2 | 18.7 | 11.0 | 14.2 | 40.9 | 1.0 |
| Offline discussion | 7.1 | 24.8 | 21.8 | 20.9 | 24.1 | 1.3 |

Source: own computations based on representative raw data from Sociologický ústav. Akademie věd ČR. (2021).

SD: 47.74 ± 17.66) education (19.40% with higher education), political orientation (1 left–11 right, M ± SD: 6.56 ± 2.27), subjective town size (21.5% big city, 3.4% suburb of big city, 26.7% average town, 24.7% small town, 8.9% big village, 14.3% small village).

# 6 The method

Methodologically we rely on Principal component analysis to study the structure of attitudes to environmental protection and climate change. Namely, we are interested in whether the agendas of environmental protection and climate change represent one or two different agendas in the minds of the representative sample of the population in the Czech Republic. In theory, the agenda of climate change represents a subset of the agenda of environmental protection. However, the literature review suggested that according to the media presentation and the non-availability of personal experience, they may present two different agendas.

Second, we conduct ordinal regression analyses to test the factors associated with environmentally conscious behavior according to the scheme presented in Supplementary Appendix S1 (Table 1A); Formula 1.

$$\begin{aligned} Behavior_i = logit\,(a_0 &+ a_{1-3}Environment + a_{4,5}Climate + a_{6-8}EU \\ &+ a_{9-15}Info + a_{16}Standart + a_{17}Gender + a_{18}Age \\ &+ a_{19}Political\,orientation + a_{20-22}Education \\ &+ a_{23-27}Town\,size + e \end{aligned} \tag{1}$$

Where

*Behavior*$_i$–stands for the frequency of conducting environmentally conscious activities consequently (buy organic food, buy locally produced food, when buying products you are guided by whether they are environmentally friendly, hand in, sort your hazardous waste, sort your regular waste, limit car journeys to protect the environment, save energy and water to protect the environment, for the distribution of the respondents see Table 1)

*Environment*–three variables capturing environment protection attitudes, namely: 1) the extent the environment protection is urgent, 2) the level of satisfaction with the environment in the locality of the respondent, 3) the extent the respondent has sufficient information about how to behave in an environmentally friendly way (for the distribution of the respondents see Table 2)

*Climate*–stands for two variables reflecting concerns about the effects of climate change and whether the respondents believe that people's behavior can change climate change (for the distribution of the respondents, see Table 2)

*EU*–stands for the three variables reflecting the attitude to EU policies: whether European integration in the fields of economy and environment is beneficial or harmful, and the extent to which the respondents trust the EU.

*Info*–stands for the six variables reflecting the frequency the respondents follow social life in the following media: TV, printed newspapers and magazines, radio, online news serves, social networks, and offline discussions (for the distribution of the respondents, see Table 3).

*Standard*–subjective standard of living of the respondents (very good to very bad, five-point scale).

*Gender and Age*–stands for the gender and age of the respondents.

*Political orientation*–political orientation (left-right, eleven-point scale).

*Education*–education dummies (primary, secondary w/o state exam, secondary with state exam, higher; higher education is reference variable).

*Town size*–dummies for subjective town size (big city, suburb of big city, average town, small town, big village, small village).

The bivariate correlations between the variables above are presented in Supplementary Appendix S1.

# 7 Results and discussion

## 7.1 Results

Before conducting ordinal regression, we run principal components analysis for the indicators of concerns with the environment and climate to study the internal structure represented by components.

**TABLE 4 The Principal Component Analysis of concerns with the environment and climate change. Rotated component matrix.**

| | Component | |
|---|---|---|
| | 1 | 2 |
| Behavior affects climate | **0.786** | −0.006 |
| Concerns about climate change | **0.743** | −0.221 |
| Satisfaction with the environment in locality of residence | −0.105 | **0.780** |
| Urgent areas - environment | −0.215 | **0.608** |
| Enough info about environment | 0.372 | **0.487** |

Bold values in highlite the variables belonging to particular components in Principal Component Analysis.

**TABLE 5 The Principal Component Analysis of concerns with the environment and climate change. Total variance explained.**

| Component | Rotation sums of squared loadings | | |
|---|---|---|---|
| | Total | % of variance | Cumulative % |
| 1 | 1,365 | 27.3 | 27.3 |
| 2 | 1,264 | 25,278 | 52,579 |

Extraction Method: Principal Component Analysis.

### 7.1.1 Concerns with the environment and climate change. The principal component analysis

As environmental protection and climate change largely represent different agendas in the media, we conducted correlation analysis and Principal component analysis for the indicators of environmental concerns and the concerns with climate change.

The Principal Component Analysis of climate change indicators and environmental concerns are presented in Tables 4, 5. An Eigenvalue of 1 or higher determined the number of factors extracted. The Bartlett test of sphericity with a Chi-Square value 163.50 ($p < 0.001$) and Kaiser-Meyer-Olkin Measure of sampling adequacy was equal to 0.550 (> 0.5), suggests that the data are suitable to identify factor dimensions.

The results suggest that perceptions of climate change and environmental concerns present two largely independent categories (slight correlation was reported only in the case of concerns about climate change on the one hand and satisfaction with the environment of the respondent in the locality where he lives and perception that environment is an urgent issue, see Supplementary Appendix S2).

The correlation matrix of environmentally conscious behavior and concerns about the environment and climate change is presented in Supplementary Appendix S2.

The results of ordinal regression (logit) according to Formula 1 are presented in Table 6

Table 7 summarizes the results presented in Table 6.

Environment protection attitudes predicted a higher frequency of purchasing local products and environmentally friendly products (Table 7). However, environmental protection indicators were not associated with purchasing of organic food. Concerns about climate change predicted higher purchasing of organic food and environmentally friendly products but were unrelated to purchasing local food. On the other hand, the perception that behavior can affect climate predicted higher purchasing of local food (Table 7).

The positive attitude to EU integration predicted higher purchasing of organic food and environmentally friendly products but was unrelated to local food purchasing. Right-wing political orientation predicted higher values in all three indicators of green consumption.

The impact of the exposition to the media provided a controversial picture as printed media and online discussion forums and blogs predicted higher purchasing of organic food and environmentally friendly products. In contrast, exposure to social media negatively impacted organic food purchasing. However, the frequent use of social networks positively predicted purchasing of local food. Surprisingly, frequent exposition to TV negatively predicted purchasing of environmentally friendly products.

Age, gender, and education were also associated with green purchasing. Women engaged more in environmentally conscious purchasing than men. Higher-educated respondents purchased more organic and local food. Age was related to lower organic food purchasing. People living in small villages purchase more organic food than those living in other settlements.

## 7.2 Discussion

The literature suggested six major factors impacting environmentally conscious consumption—1) economic incentives and possibilities, 2) socio-demographic segmentation, 3) values emotions and personal responsibilities, 4) sources and sufficiency of information, including education and mass media, 5) factors related to locality of the respondents including lifestyles (Peattie, 2010). Empirical studies report that some of the factors contradict each other, making the effects unpredictable. This study researched the effects of the environment- and climate-related values, political preferences, economic position (measured by the standard of living), information (whether the respondent has enough information about the environment, education, exposition to mass-media), and socio-demographic values.

The results of the principal component analysis suggest that the population considers the agendas of climate change and environmental protection as two different agendas. While environmental degradation is evident to the public, the disadvantages of climate change are less direct. Moreover, the presentation of climate change in the media results in polarization of opinions both on the existence and long-lasting nature of climate change and on the negative effects of climate change (Li, et al., 2013; Matakos, et al., 2017; Gubanov and Petrov, 2019). Some people believe climate change presents more advantages than disadvantages in the Czech Republic as temperature increase may reduce the necessity to heat houses in winter and possibly allow to collect two harvests per year (Cabelkova et al., 2022).

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**TABLE 6 Environmentally conscious purchasing as predicted by environment protection, concerns about climate change, EU policies, exposition to media, and socio-demographics. Results of ordinal regression analysis.**

| | Buys organic food | | Buys local food | | Buys environmentally friendly products | |
|---|---|---|---|---|---|---|
| | Estimate | Sig | Estimate | Sig | Estimate | Sig |
| Threshold = 1 | 0.631 | 0.483 | −0.209 | 0.821 | −0.75 | 0.387 |
| Threshold = 2 | **3.1***** | **<0.001** | **3.262**** | **<0.001** | 1.349 | 0.117 |
| Threshold = 3 | **5.654***** | **<0.001** | **5.787**** | **<0.001** | **3.168***** | **<0.001** |
| Environment protection | | | | | | |
| Urgent areas - environment | −0.005 | 0.960 | **−0.235*** | **0.031** | **−0.243*** | **0.011** |
| Satisfaction with the environment | −0.131 | 0.303 | **0.383**** | **0.004** | 0.209 | 0.098 |
| Enough info about environment | −0.034 | 0.784 | **0.261*** | **0.046** | **0.269*** | **0.030** |
| Concerns about climate change | | | | | | |
| Behaviour affects climate | 0.056 | 0.770 | **0.449*** | **0.023** | 0.063 | 0.738 |
| Concerns about climate | **0.467***** | **<0.001** | 0.076 | 0.532 | **0.516***** | **<0.001** |
| EU policies | | | | | | |
| EU integration, environment | **0.298*** | **0.024** | 0.019 | 0.891 | **0.283*** | **0.031** |
| EU integration, economy | 0.031 | 0.815 | −0.016 | 0.910 | −0.122 | 0.356 |
| Trust to EU | 0.137 | 0.292 | 0.026 | 0.849 | −0.087 | 0.490 |
| Political orientation (left-right) | **−0.143***** | **<0.001** | **−0.149***** | **<0.001** | **−0.112**** | **0.005** |
| Exposition to media | | | | | | |
| TV | −0.182 | 0.052 | −0.118 | 0.229 | **−0.244**** | **0.008** |
| Printed media | **0.226**** | **0.005** | 0.067 | 0.416 | 0.120 | 0.130 |
| Radio | −0.004 | 0.958 | 0.056 | 0.441 | −0.022 | 0.754 |
| Online news | 0.018 | 0.826 | 0.108 | 0.202 | −0.054 | 0.502 |
| Online discussions, blogs | **0.209*** | **0.014** | 0.052 | 0.565 | **0.252**** | **0.003** |
| Social networks | **−0.166*** | **0.036** | **0.005*** | **0.951** | −0.042 | 0.587 |
| Offline discussions | 0.106 | 0.169 | −0.018 | 0.820 | 0.055 | 0.468 |
| Socio-demographics | | | | | | |
| Standard of living | 0.034 | 0.770 | 0.127 | 0.293 | 0.036 | 0.749 |
| Gender (men) | **0.371*** | **0.038** | **0.381*** | **0.041** | **0.479**** | **0.007** |
| Age | **0.022***** | **<0.001** | 0.001 | 0.846 | −0.004 | 0.586 |
| Education | | | | | | |
| Basic | **0.779*** | **0.027** | **0.821*** | **0.023** | −0.024 | 0.944 |
| Secondary w/o state exam | **0.733**** | **0.004** | **0.687*** | **0.011** | 0.048 | 0.847 |
| Secondary with state exam | **0.567*** | **0.016** | 0.393 | 0.120 | 0.139 | 0.547 |
| Subjective town size | | | | | | |
| Large City | **0.919**** | **0.003** | **0.712*** | **0.027** | 0.061 | 0.841 |
| Large city suburb | 0.495 | 0.347 | **−1.450**** | **0.008** | −0.842 | 0.107 |
| Average town | **0.672*** | **0.022** | −0.273 | 0.374 | −0.258 | 0.369 |

(Continued on following page)

**TABLE 6 (*Continued*) Environmentally conscious purchasing as predicted by environment protection, concerns about climate change, EU policies, exposition to media, and socio-demographics. Results of ordinal regression analysis.**

| | Buys organic food | | Buys local food | | Buys environmentally friendly products | |
|---|---|---|---|---|---|---|
| | Estimate | Sig | Estimate | Sig | Estimate | Sig |
| Small town | **0.571*** | **0.049** | −0.401 | 0.192 | −0.214 | 0.454 |
| Big village | 0.612 | 0.100 | −0.275 | 0.484 | −0.095 | 0.799 |
| N | 531 | | 531 | | 505 | |
| Sig | | <0.001 | | <0.001 | | <0.001 |
| Pseudo R-Square | | | | | | |
| Cox and Snell | 0.232 | | 0.176 | | 0.161 | |
| Nagelkerke | 0.257 | | 0.201 | | 0.175 | |
| McFadden | 0.113 | | 0.093 | | 0.069 | |

Link function: Logit., reference variables: women, higher education, small village. *** significant at the 0.001 level (2-tailed). ** significant at the 0.01 level (2-tailed). * significant at the 0.05 level (2-tailed). Source: own computations based on data (Sociologický ústav. Akademie věd ČR. 2021).
Bold values in highlight statistically significant values.

In general, the interest of Czech respondents in climate change issues is rather low. Only 20% of the respondents reported that they were interested or rather interested (ibid.). Despite the little interest, 86% of the respondents believe the change is happening (the climate has changed during the last 100 years, ibid.)

The difference in environmental protection and climate change agendas was most reflected in the frequency of buying organic food. Surprisingly, the propensity to purchase organic food was predicted by concerns with climate change but was unrelated to all three indicators of environmental protection. The organically managed farms were previously shown to mitigate climate change through the reduction of N2O emissions from soils (the potential was reported to be about 20% of emissions, Scialabba and Müller-Lindenlauf, 2010) and carbon sequestration [the potential is about 40%–72% of the world's current annual agricultural greenhouse gas (GHG) emissions, ibid.]. On the other hand, the yields from organic farming proved to be lower, and if the whole cycle of production is taken into account, the benefits of organic farming from the reduction of GHG emissions are not that certain.

The lack of association between indicators of environmental protection and the frequency of purchasing organic food is intriguing, as, previously, the association was rather supported by the literature (Janssen, 2018; for the review, see Suciu et al., 2019). We can hypothesize that previous authors included climate change in the definition of environmental concerns.

The perception of EU integration positively predicted purchasing organic food and environmentally friendly products. The EU organic certificates and Ecolabelling may play a large role. However, local food purchasing was not associated with EU policies, possibly reflecting the lack of visibility of EU policies.

The role of mass media in environmentally conscious purchasing proved to be very controversial. Larger exposure to printed media, online discussions, and blogs positively predicted purchasing organic food and environmentally friendly products. The exposure to social networks reduced buying organic food, and surprisingly, exposure to TV reduced purchasing environmentally friendly products.

The role of social networks needs more attention as exposure to this media negatively affected buying organic food and sorting common waste, though it positively predicted purchasing local food. The propensity of social networks to form information bubbles may create these phenomena, which need to be studied.

The negative effect of TV on purchasing environmentally friendly products needs to be studied from the traditional journalistic point of view. The presentation of the environmental agenda is subject to numerous biases starting from the topic, through the way of presentation, and ending with conclusions and socially desirable outcomes. From this point of view, it is even more alarming that the media negatively affect environmentally conscious behavior. We can hypothesize that there might be certain self-selection. In many cases, people most exposed to TV have it as a background to other activities rather than actively watching. Thus, the sole fact of exposition might define the group as people working with the information differently, which may also correlate with a lack of environmental concern. TV exposure as a factor of self-selection needs to be analyzed. We also suggest that TV advertisements often emphasize low price rather than environmental benefits, making consumers more price sensitive and less willing to pay a premium for green products.

The positive effect of right-wing political orientation on environmentally conscious purchasing, similar to the attitude to EU integration, presents the political aspect of the environmental efforts.

## 8 Conclusion

Green purchases are indispensable for environmental protection and combatting climate change. The relevant information is, in most

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**TABLE 7 Predicting environmentally conscious consumption. Results of ordinal regression analyses. Statistically significant associations on conventional levels (5%, 1%, and 0.1%). Brief summary.**

| | Frequency of purchasing of | | |
|---|---|---|---|
| | Organic food | Local food | Environmentally friendly products |
| **Environment protection** | | | |
| Urgent areas - environment | | + | + |
| Satisfaction with the environment | | + | |
| Enough info about environment | | + | + |
| **Concerns about climate change** | | | |
| Behavior affects climate | | + | |
| Concerns about climate | + | | + |
| **EU policies and political orientation** | | | |
| EU integration, environment | + | | + |
| EU integration, economy | | | |
| Trust to EU | | | |
| Political orientation (left-right) | + (right) | + (right) | + (right) |
| **Exposition to media** | | | |
| TV | | | - |
| Printed media | + | | |
| Radio | | | |
| Online news | | | |
| Online discussions, blogs | + | | + |
| Social networks | - | + | |
| Offline discussions | | | |
| **Socio-demographics** | | | |
| Standard of living | | | |
| Gender (women) | + | + | + |
| Age | - | | |
| **Education** | | | |
| Basic | - | - | |
| Secondary w/o state exam | - | - | |
| Secondary with state exam | - | | |
| **Town size** | | | |
| Large City | - | - | |
| Large city suburb | | + | |
| Average town | - | | |
| Small town | - | | |

Note: + denotes positive association, - denotes negative association. The signs of the associations might be different from the signs of coefficients presented in tables 6 and 7 as they reflect the encoding of the variables. Reference variables: men, higher education, small village. The exact wording of the associations depicted in the table is presented in Appendix 3.

cases, distributed to the general public via education, mass media, green marketing, certification, and labeling. In Europe, the EU plays a major role in determining environmental policies and the provision of relevant certificates.

The existing literature established that attitudes to environmental protection and climate change, among other factors such as values, beliefs, lifestyles, and orientations, significantly affect the propensity of the population for green purchasing (Wijekoon and Sabri, 2021), though certain green attitude-behavior gap (Wang, et al., 2019b; Witek, 2019), limits the applicability of these findings. On the other hand, the intention to purchase and the purchase itself are shown to be driven by the same determinants (Janssen, 2018). In this field, research on the media's role in green purchases is still largely missing (Chen et al., 2019).

This paper studied the effects of attitudes to environmental protection, climate change concerns, and EU integration, and mass media (traditional and new ones) on the reported frequency of green purchases of households. Predictably, environmental attitudes and climate concerns positively predicted green purchases. The EU integration was the most important in the sense of environmental integration.

However, the most problematic effects were shown on the side of mass media as the exposure to TV and social networks diminished green purchasing. We suggest that information bubbles that polarize opinions (most frequent in social networks) cause this unfortunate outcome (see also Pearce et al., 2019). Besides the content, the negative effect of TV might be caused by significant self-selection or inappropriate advertisement that primarily emphasize the price Both of these effects need to be studied. In any case, more efforts must be made by the TV and social networks to increase the population's awareness on green products.

The impact of the paper is twofold. First, the paper contributes to the empirical literature on green consumption by analyzing value, information, and media factors affecting green consumption. Second, the paper poses significant problems to policymakers and media experts. As exposition to TV and social networks was shown to diminish green consumption, policymakers and journalists need to concentrate on these two media channels to reverse the unfavorable trends. Especially video-content, so vital for green consumption intentions (Ramkissoon and Smith, 2014), should be analyzed and modified accordingly in these two media outlets.

## Limitations and suggestions for further research

The biggest limitation of this research is the discrepancy between the positive attitude and actual green purchases ('green purchasing inconsistency' or 'green attitude-behavior gap, Witek, 2019; Wang et al., 2019b; Joshi and Rahman, 2015). However, this problem is partially reduced by the fact that the questions in the questionnaire were formulated as the frequency of actual purchasing rather than the intention to purchase. Moreover, the intention to purchase and the purchase itself are shown to be driven by the same determinants (Janssen, 2018).

The impact of the mass media (online and offline) on environmentally conscious consumption showed the biggest controversy, which needs to be studied further. TV and Social networks proved to reduce several indicators of environmentally conscious consumption. We suggest that the nature of these effects is twofold and may not necessarily be related to the content. First, the frequent use of both media implies certain self-selection. Second, especially in the case of social networks, the role of information bubbles and polarizations needs to be studied. In the case of TV, we can hypothesize that many of the respondents, who report watching TV on a daily basis, use TV programs as a background to their daily activities. The emotional need of this background may define the group.

On the other hand, there might be a considerable percentage of people watching TV news on a daily basis. Given the existence of alternative news sources, this group also may share certain characteristics that distinguish them from others and define the negative association between the frequency of watching and environmentally conscious behavior.

The other avenue for further research may lie in the area of political preferences. The role of political orientation and the perception of EU integration proved to be significant factors for purchasing decisions but not for saving resources or waste management. These effects need to be explained

## Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: Sociologický ústav. Akademie věd ČR. 2021. Centrum pro výzkum veřejného mínění. Naše společnost 2021—červenec [datový soubor] [online]. Ver. 1.0. Praha: Český sociálněvědní datový archiv, 2021 [Accesed 27.10.2022]. DOI 10.14473/V2107 https://archiv.soc.cas.cz/cz/#utm_source=firmy.cz&utm_medium=ppd&utm_campaign=firmy.cz-2200848.

## Ethics statement

The studies involving human participants were reviewed and approved by Ethics committee of the Czech University of Life Sciences. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

Conceptualization, IC, and LS; methodology, IC; data curation, MH; writing—original draft preparation, MH and DB; writing—review and editing, MH, LS, IC, DB, and PP; supervision, LS; project administration, LS; funding acquisition, LS. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fenvs.2023.1130533/full#supplementary-material

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# An empirical analysis of the factors driving customers' purchase intention of green smart home products

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With the improvement of consumers' environmental awareness and the popularity of the Internet of Things, green smart home products (GSHPs) are becoming the dominant trend of future home life. This shift not only makes tedious home life easier and more convenient but also helps families save energy and reduce carbon emissions. However, given the impact of the current technological level, the proportion of users who actually purchase GSHPs remains small. Thus, seeking ways to promote the consumption of GSHPs has become an urgent issue. Hence, this study seeks to fill the gap in the existing research on green consumption behavior and obtain a full understanding of the factors influencing the purchase intention of GSHPs. To do so, this work uses task-technology fit theory and considers the actual situation of green smart home consumption to add social-technology fit into the original theoretical basis. In particular, this research focuses on middle- and high-end Chinese consumers who have experience in purchasing GSHPs. Moreover, it aims for an in-depth exploration of the formation mechanism of Chinese consumers' purchase intention for GSHPs through structural equation modeling. Using survey data collected from 331 green smart home product users in China, the study empirically examines the relationships among autonomy, environmental agility, sense of belonging, and self-actualization, and both task-technology fit and social-technology fit, which are expected to shape the purchase intention of GSHP users. The empirical results provide broad support for our hypotheses. The results of this study offer important contributions to the increasing research on GSHPs consumption and shed light on the importance of both technology characteristics and the needs of users in achieving both task-technology fit and social-technology fit and, ultimately enhancing the users' intention to purchase GSHPs.

KEYWORDS

**green smart home products, sense of belongings, self-actualization, task-technology fit, social-technology fit, purchase intention**

## 1. Introduction

With the rapid development of Internet technology and the continuous improvement of people's demands for living environments, the shortcomings of traditional home products in terms of safety, resource waste, and lack of passivity have become increasingly prominent (Teoh et al., 2022). This circumstance has given rise to green smart home products (GSHPs). After installing a green smart home system, consumers can monitor their security system remotely.

Furthermore, intelligent devices, such as smart door locks and high-definition cameras, can provide real-time protection for home safety throughout the day. These technologies are also environmentally friendly because smart homes are activated only when needed or when sensing an order. Thus they effectively avoid the wastage of water and electricity that often results from forgetting to turn off lights or close faucets. In terms of convenience, GSHPs can be connected into a single ecosystem, thereby enabling interoperability and intelligent control. Compatible with the modern and fast-paced life and work rhythm, GSHPs present a substantial advantage in liberating people from tedious chores, satisfying the demand for consumption upgrades, and ensuring a leisurely and relaxed life. Moreover, the thriving of smart homes will stimulate the development of the home products industry and related upstream and downstream industries, which can boost economic growth. However, given the impact of the current level of technology, the actual proportion of GSHP users remains small. As such, accelerating the potential of green smart home consumption has become an urgent problem. Utilizing the characteristics of GSHPs to accurately match consumers' mental life needs has become a new research perspective.

In the extant literature, two different opinions have emerged regarding how consumers perceive GSHPs. On the one hand, some scholars have explored the positive effects of smart home technology on consumers' purchase intentions. Smart homes, through centralized and intelligent control of lighting, heating, air conditioning, and other household systems and related devices, can provide consumers with optimal convenience, comfort, and safety while improving energy efficiency (Luor et al., 2015). Green smart home technology can simultaneously meet consumers' functional and hedonic goals; moreover, using GSHPs allows consumers to save energy, control the ambient environment, enhance security, and provide additional entertainment and enjoyment (Wilson et al., 2017). Smart home technology enables consumers to access, manage, and monitor home products remotely via user interfaces on mobile devices, thus eliminating time and space constraints; it also allows consumers to control home devices remotely and contributes to the enhancement of the consumption experience (Yang et al., 2017). As innovative technological products, GSHPs can provide consumers with unprecedented techno-coolness, thus allowing them to experience technological advances and making their homes modern and futuristic. Techno-coolness can help consumers achieve complex psychological goals, such as enhancing interaction with others and self-achievement, thereby promoting consumers' purchase intentions (Mamonov and Koufaris, 2020). GSHPs can aid consumers in achieving practical functionality and psychological goals. Meanwhile, these products can also reduce individuals' environmental impact, particularly by controlling the use of energy and water in homes; in doing so, these technologies help consumers achieve their environmental goals through technological innovation (Schill et al., 2019; Sovacool and Del Rio, 2020).

On the other hand, some experts have raised concerns about the promotion of GSHPs. Home is an independent and private space where consumers seek shelter and sanctuary. The introduction of GSHPs may undermine consumers' control of their home environment and trigger concerns about privacy loss (Hong et al., 2020; Mamonov and Koufaris, 2020). In the event of hacker attacks and technical failures, GSHP consumers are more likely to suffer the most losses (Yang et al., 2017). Although GSHPs can achieve energy conservation through technological means, they also consume a substantial amount of energy. Some energy-consuming features include automated security monitors and Internet connectivity. Backend services for these products, such as cloud storage servers, can also put pressure on energy resources. These challenges may have negative impacts on the consumption of GSHPs (Wilson et al., 2017). The adoption of GSHPs is a disruption to the existing home living habits and requires the continuous learning and adaptation of all family members. The learning and mastery of technology can be complicated and time-consuming, which may potentially result in an inadequate grasp of all the operations of GSHPs and the partial use of some functions. Moreover, the energy-saving potential claimed by GSHPs has not been confirmed in consumers' actual use, which can also affect their consumption experience of these products (Hargreaves et al., 2018). Currently, consumers are not adequately familiar with green smart home technology and cannot fully adapt to the lifestyle changes brought about by these new products, thus potentially hindering the further promotion of GSHPs (Hong et al., 2020).

The existing literature on factors influencing consumers' purchase intention for GSHPs has been inconsistent, and the relationship between smart home technology and consumers' purchase intention remains unclear. Therefore, to fill the gaps in the existing research on green consumption behavior, this study aims to clarify the influencing factors of consumers' purchase intentions for GSHPs by empirically analyzing how the characteristics of GSHPs, consumers' needs, and their fitness work in the process of consumption decision-making. Inspired by task-technology fit theory and considering the actual situation of green smart home consumption, this study adds social-technology fit to the original task-technology fit framework. Furthermore, this study focuses on Chinese middle- and high-end consumers who have purchased GSHPs, the study aims to explore the formation mechanism of Chinese consumers' purchase intention for GSHPs. In this research, autonomy and environmental agility are considered as the technology characteristics of GSHPs, while consumers' needs for a sense of belonging and self-actualization are regarded as task features. The technology characteristics and task features are studied as independent variables. Moreover, task-technology fit and social-technology fit act as mediating variables, and purchase intention for GSHPs is the dependent variable. This research aims to understand the factors affecting consumers' purchase intention for GSHPs comprehensively. It seeks to broaden the scope of existing green consumption research and contribute to the popularization of GSHPs and the maximization of their consumption potential.

## 2. Theoretical background and hypothesis development

Abraham Maslow's hierarchy of needs theory aims to explain the relationship between human needs and behavior, which asserts that human needs will influence their behavior. Maslow has divided human needs into five levels, and from the lowest to the highest are physiological needs, safety needs, belongingness needs, esteem needs, and self-actualization needs, respectively. Each level is interconnected and built on the level below it; one can only progress to higher-level needs when lower-level needs are met (Maslow, 1987; Fives and Mills, 2016). In the research field of consumer behavior, the hierarchy of

needs is widely applied to studies related to consumers' purchase intentions and behavior, such as motivations for purchasing electric vehicles (Cui et al., 2021), adoption of virtual reality technologies for ocean conservation (Yuen et al., 2022), and usage preferences for reusable delivery bags (Su et al., 2023).

However, as technology advances rapidly, focusing the research solely on needs cannot fully explain consumers' purchase behavior. Determining whether technology can meet consumers' needs and the extent to which it can satisfy different needs is equally important. Therefore, this study also refers to task-technology fit theory. Task-technology fit involves the relationship between a specific technology and individual performance, which includes technology characteristics, task characteristics, and task-technology fit as the three main structures. Technology characteristics are the key features of a product that allow users to complete related tasks. Meanwhile, task characteristics refer to the outcomes users expect to achieve by using technology (Goodhue, 1995; Zhou et al., 2010). Technology characteristics and task characteristics are the antecedent variables affecting task-technology fit, which entails that users' adoption of a particular technology depends on the match between technology and their task requirements. Users will adopt the technology only if it can match their tasks and improve their performance (Goodhue, 1995; Goodhue and Thompson, 1995). Task-technology fit theory has been applied to users' technology adoption behaviors, such as mobile banking (Zhou et al., 2010; Oliveira et al., 2014), MOOCs (Wu and Chen, 2017), purchase intention of organic food (You et al., 2020), augmented reality technology (Faqih and Jaradat, 2021), and smart speakers (Ling et al., 2021).

This study aims to fill the research gap in consumers' green purchase behavior by exploring the relationship between the characteristics of GSHPs and the needs of contemporary consumers. In addition, it clarifies the factors influencing consumers' GSHP purchase intention. This study refers to task-technology fit theory and uses the autonomy and environmental agility of GSHPs as the technology characteristics. With the guidance of the hierarchy of needs theory, it considers the sense of belonging and self-actualization as the task characteristics. We present the conceptual framework in Figure 1. As shown in Figure 1, the theoretical model is constructed with technology characteristics and task characteristics as independent variables, task-technology fit and social-technology fit as mediating variables, and consumers' GSHPs purchase intention as the dependent variable.

## 2.1. Technology characteristics and task-technology fit

Task-technology fit is the core element of the task-technology fit model, which refers to the degree of fit between the characteristics of technology and the tasks that the users need to accomplish (Goodhue, 1995; Yang et al., 2022). One of the technology characteristics of GSHPs is autonomy, which means that they can operate independently in a goal-directed way (Rijsdijk et al., 2007; Rokonuzzaman et al., 2022). Guided by orders from a computer, smartphone, or intelligent speaker, GSHPs can perform the expected operations automatically (Yang et al., 2017). Given its autonomy, GSHPs can reduce time and space constraints during utilization compared with traditional products (Hoffman and Novak, 2018). An increasing number of smart home devices, including electrical appliances, lighting, and security devices, have transformed homes into fully automated residences (Aldrich, 2003; Lee, 2020). In a smart home, consumers can activate their home mode through a smart system app, voice command, or even a gesture. When users return home, the connected smart products can respond automatically and simultaneously, such as by turning on the lights, playing background audio and television, closing the curtains, and activating security systems. The functions of a smart home product can be customized according to individual needs; moreover, the devices can be controlled automatically on the basis of the settings or requirements of the users for an optimal experience (Cook, 2012). Autonomy facilitates the efficiency of home products, saves time, and makes home life more convenient (Luor et al., 2015). In summary, the autonomy of GSHPs will facilitate the satisfaction of consumers' needs.

Another significant feature of GSHPs is environmental agility, which refers to the ability of GSHPs to observe the surrounding environment and respond to environmental changes and user requirements (Rokonuzzaman et al., 2022). GSHPs can not only react to their surroundings but also actively explore and analyze the environment through built-in sensors (Rijsdijk and Hultink, 2009; Hoffman and Novak, 2018). Relying on the observations, GSHPs can perform operations through built-in actuators and provide intelligent services to their users (Raff et al., 2020). Environmental agility allows home products to learn from and respond to external environments. For instance, smart air conditioners can adjust modes according to indoor temperature and humidity changes, and smart lighting systems can automatically turn on or off depending on the changes in ambient brightness (Cook, 2012). Environmental agility also has great potential to reduce household energy consumption, improve energy utilization, and achieve green environmental goals (Rokonuzzaman et al., 2022). In summary, the environmental agility of GSHPs will have a positive impact on task-technology fit. The above discussion leads to the following hypotheses:

> *Hypothesis 1*: Autonomy has a positive impact on task-technology fit.
>
> *Hypothesis 2*: Environmental agility has a positive impact on task-technology fit.

## 2.2. Technology characteristics and social-technology fit

Social-technology fit refers to the extent to which technology can help users fulfill their social needs (Lu and Yang, 2014). The autonomy of GSHPs emphasizes automation and independence in the operation of GSHPs (Rijsdijk et al., 2007; Rokonuzzaman et al., 2022). Environmental agility implies that GSHPs not only respond to external changes in the surrounding environment but also have the potential to optimize their responses by collecting and processing information from the surroundings (Rokonuzzaman et al., 2022). Besides the ability to manage internal household devices, predict users' needs, and respond to these needs, smart home technology can also help its users establish connections with the outside world (Aldrich, 2003). Compared with traditional home products, GSHPs have a higher level of intelligence, thus giving consumers a sense of

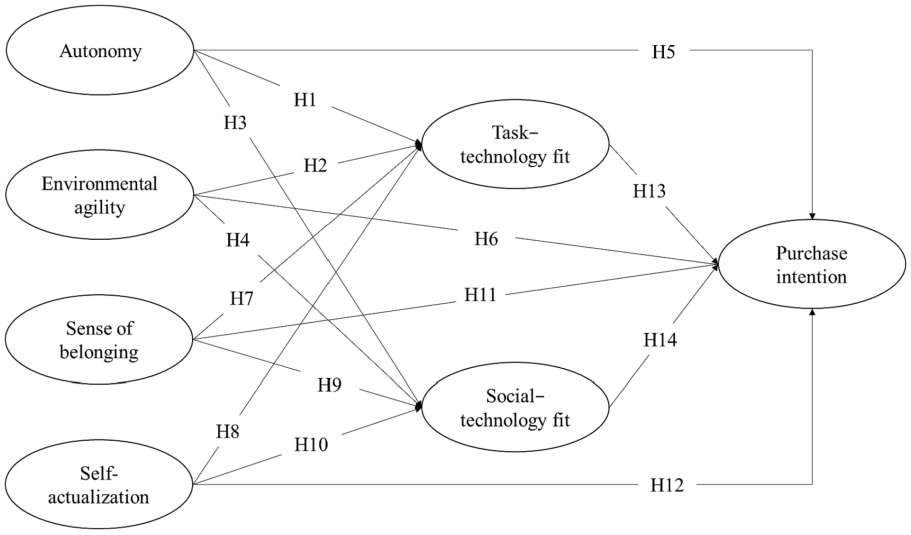


FIGURE 1
Research model and proposed hypotheses.

superiority (Rijsdijk and Hultink, 2009). Autonomy and environmental agility demonstrate the technological innovation of home products. The techno-coolness of smart thermostats helps consumers to project an improved self-image and satisfy their expectations for social recognition, reputation, and social status (Mamonov and Koufaris, 2020). Meanwhile, the global energy crisis and rising energy prices have raised consumers' environmental awareness. Related research has found that the consumption of green products will be beneficial for establishing a better social status and improving personal image (Khan and Mohsin, 2017). The autonomy and environmental agility of GSHPs can reduce energy consumption in home life. Thus, the purchase of GSHPs is expected to contribute to establishing a user's green consumer image. In summary, the autonomy and environmental agility of GSHPs are expected to have a positive impact on social-technology fit. The above discussion leads to the following hypotheses:

> *Hypothesis 3*: Autonomy has a positive effect on social-technology fit.
>
> *Hypothesis 4*: Environmental agility has a positive effect on social-technology fit.

## 2.3. Technology characteristics and consumers' purchase intention

Technology characteristics provide performance warranties and sources to ensure consumer confidence. Moreover, users' perception of the technology characteristics will indicate the potential adoption of smart home technology (Wilson et al., 2017). Earlier studies have found that the level and reliability of smart home technology is the most important deterministic factor influencing consumers' acceptance of smart home products (Schomakers et al., 2021; Li et al., 2023). As the most distinctive features of smart home technology, the autonomy and environmental agility of GSHPs will directly influence consumers' purchase intention for such products, along with a high perception of autonomy and environmental agility and a high likelihood of purchase intention. The above discussion leads to the following hypotheses:

> *Hypothesis 5*: Autonomy positively affects consumers' purchase intention for GSHPs.
>
> *Hypothesis 6*: Environmental agility has a positive effect on consumers' purchase intention for GSHPs.

## 2.4. Task characteristics and task-technology fit

Task-technology fit refers to the degree of fit between task characteristics and technology characteristics (Goodhue, 1995). According to Maslow's hierarchy of needs, people are always seeking to satisfy higher-level needs. A sense of belonging arises when physiological and safety needs are largely satisfied; furthermore, people yearn for intimate relationships with others (Maslow, 1987; Fives and Mills, 2016). The need for belongingness emphasizes an individual's emotional involvement with a certain group, thus implying the alignment of personal goals with those of other group members and the acquisition of social recognition from the group (Cheung and Lee, 2012). People always desire opportunities to connect and communicate with others. The adoption of health-related products and technologies by the elderly mainly depends on whether the technology and products can enhance their sense of belonging (Thielke et al., 2012). In other words, the stronger the consumers' need for a sense of belonging is, the more likely they will expect innovative technology to meet their needs. Therefore, a sense of belonging is expected to have a positive impact on task-technology fit.

Self-actualization is the highest level of need in Maslow's theory. When other needs are met, people will seek to satisfy their need for self-actualization through participating in creative activities (Thielke et al., 2012). Self-actualization is a fundamental motivation for self-development and self-improvement and is closely related to an individual's sense of self-fulfillment. It refers to the desire to achieve one's unique and idiosyncratic existence (Taormina and Gao, 2013). Furthermore, a strong need for self-actualization will result in a high willingness to engage in consumption behavior (Fraj and Martinez, 2006). The adoption of GSHPs can provide a platform for users to acquire knowledge and resources for self-improvement and personal growth (Zhao et al., 2011). Consumers with a stronger need for self-actualization will show greater expectations of GSHPs for satisfying their needs. Therefore, self-actualization is expected to have a positive impact on task-technology fit. The above discussion leads to the following hypotheses:

> *Hypothesis 7*: Sense of belonging has a positive effect on task-technology fit.
>
> *Hypothesis 8*: Self-actualization has a positive effect on task-technology fit.

## 2.5. Task characteristics and social-technology fit

Social-technology fit emphasizes the degree of fit between social needs and technology, where social needs encompass perceptions of image, social recognition, and others' evaluations (Ashfaq et al., 2021). Sense of belonging emphasizes the attachment relationship of an individual with a certain group (Cheung and Lee, 2012; Hawkins, 2020), while self-actualization represents the pursuit of an individual for uniqueness and self-fulfillment (Taormina and Gao, 2013). When individuals have a stronger belief in their identity as a group member, they will perceive a greater sense of belonging. Thus, they will be more willing to define themselves by their group membership and gain a sense of recognition from their group (Hawkins, 2020). With consideration of users' needs for belongingness, manufacturers of GSHPs have introduced functions that allow smart devices to connect with the devices of users' relatives or friends; these functions enable interaction with others through sharing information or inter-operating systems and social connections that are unrestricted by physical space (Lee et al., 2017). As living spaces, houses are the reflection of residents' lives and, to some extent, represent their identity and status. Compared with traditional home products, the use of GSHPs can indicate consumers' pursuit of a higher quality of life, thus revealing their identity and social status (Gram-Hanssen and Darby, 2018). In summary, the greater consumers' needs for a sense of belonging and self-actualization are, the stronger they hope to fulfill their social needs through smart home technology. The above discussion leads to the following hypotheses:

> *Hypothesis 9*: Sense of belonging has a positive effect on social-technology fit.
>
> *Hypothesis 10*: Self-actualization has a positive effect on social-technology fit.

## 2.6. Task characteristics and consumers' purchase intention

Researchers have provided some empirical evidence for the relationship between a sense of belonging, self-actualization, and consumers' purchase intention. Sense of belonging has a statistically direct influence on citizen participation in smart city projects (Lebrument et al., 2021). Meanwhile, the differences in the need degree for belonging result in discrepant purchase behaviors for counterfeit consumption (Hawkins, 2020). The pursuit of self-actualization leads to socially conscious consumption and has a direct positive association with consumers' repurchase intention for fair-trade coffee (Hwang and Kim, 2018). Therefore, a sense of belonging and self-actualization may generate a direct influence on consumers' purchase intention for GSHPs with their need for a better attachment to their groups and desire for personal growth. The above discussion leads to the following hypotheses:

> *Hypothesis 11*: Sense of belonging has a positive effect on consumers' purchase intention for GSHPs.
>
> *Hypothesis 12*: Self-actualization has a positive effect on consumers' purchase intention for GSHPs.

## 2.7. Task-technology fit and consumers' purchase intention

Consumers' purchase intention indicates that consumers are prepared to engage in purchase behavior; moreover, it is considered a direct antecedent toward purchase behavior (Lu and Yang, 2014). According to task-technology fit theory, the adoption of technology depends on the matching degree of its characteristics and the users' task needs. When the task-technology fit is high, increasing the technology usage rate and improving users' performance is possible (Goodhue, 1995; Goodhue and Thompson, 1995). Studies in various research domains have verified the relationship between task-technology fit and usage. For example, if the immediacy of mobile banking can satisfy consumers' needs for mobile transactions, it can positively promote consumers' adoption of mobile banking (Zhou et al., 2010). At the same time, if the information and entertainment function of a smart speaker can fit their user's needs for information gathering and entertainment enjoyment, consumers' purchase intention for smart speakers will be promoted by the good task-technology fit (Ling et al., 2021). In summary, task-technology fit will have a positive impact on consumers' purchase intention for GSHPs. The above discussion leads to the following hypotheses:

> *Hypothesis 13*: Task-technology fit has a positive effect on consumers' purchase intention for GSHPs.

## 2.8. Social-technology fit and consumers' purchase intention

Previous research has shown that a better social-technology fit will contribute to users' intention to adopt online social network sites (Lu and Yang, 2014). At the same time, if the technology of a certain

online social platform has a high degree of fit with users' social needs, users will experience high participation satisfaction; meanwhile, the satisfaction for information and knowledge sharing will also be improved (Wu et al., 2015). In summary, if the degree to which smart home technology meets social needs is high, consumers' purchase intention for GSHPs will be improved. The above discussion leads to the following hypotheses:

> *Hypothesis 14*: Social-technology fit has a positive effect on consumers' purchase intention for GSHPs.

# 3. Methodology

## 3.1. Sampling and data collection

According to a survey by Statista, China's smart home market is developing rapidly with global smart accessory manufacturers and IoT-related companies such as Siemens and Schneider Electric jumping into the Chinese market. The revenue of the smart home market in China reached US$26.67 billion, thereby ranking second in the world after the United States. Between 2022 and 2027, China's smart home market is expected to experience an annual growth rate of 14.36%. Furthermore, 164 million Chinese households will become active users of smart homes by 2027, with household penetration increasing from 16.6% in 2022 to 34% by 2027. Considering the scale, growth potential, and speed of China's smart home market, this study determines that focusing on middle- and high-end green consumers in China as the research target is of high research value. To assure the accuracy of the research target selection, we first found through research that Chinese green smart home consumption is mainly concentrated in the economically developed first- and second-tier cities in China. After obtaining a list of green smart home enterprises and regional consumption information from the Ministry of Industry and Information Technology of China, we commissioned a well-known local survey company in China to conduct a random survey of GSHP users in Shanghai, Beijing, and Guangzhou. A total of 387 questionnaires were collected in this survey, of which 331 were valid, with an efficiency rate of 85.53%.

To test the possibility of potential nonresponse bias in our study, we compared the differences in key demographic variables (e.g., user age, education level, and monthly income) between early-responding and late-responding participants. The results of the *t*-tests indicated no statistically significant differences ($p > 0.05$) in these users, thus suggesting that nonresponse bias was less likely to be a serious problem in our data. Furthermore, following the procedure recommended by Podsakoff et al. (2003), we also checked for the possible presence of common method variance (CMV) in our data by performing Harman's one-factor analysis. We performed exploratory factor analysis using the principal factors method by including all multiple-item scales in an unrotated factor structure. The results of the analysis indicated that no general factor was apparent in the unrotated factor structure and accounted for the majority (i.e., more than 50%) of the variance, thereby providing no evidence of potential CMV concern in the study.

## 3.2. Variables and measurement

Unless otherwise noted, we measured all main variables of interest by adopting multiple-item, seven-point Likert scales (1 = strongly disagree, 7 = strongly agree). All the measures used to assess these variables were well-developed ones in the literature. We summarized the variables and their detailed measurement in Table 1.

# 4. Analyses and results

## 4.1. Measure reliability and validity assessment

We used the structural equation modeling (SEM) method to test our proposed conceptual model empirically. Before testing the proposed hypotheses, we examined the reliability and validity of the constructs used in the study by estimating a measurement model. Table 1 presents the results of reliability and validity assessments. As shown in Table 1, the outer factor loadings of all research constructs were statistically significant ($p < 0.001$) and higher than the commonly accepted benchmark of 0.70. Moreover, the Cronbach's alpha and composite reliability (CR) values for each of the constructs were higher than 0.70. These results demonstrated the strong reliability of all the constructs in the model (Fornell and Larcker, 1981). In addition, we calculated the average variance extracted (AVE) values to assess the convergent validity of the constructs. Table 1 shows the AVE values for each of the constructs were higher than the recommended threshold of 0.50, suggesting an adequate convergent validity of the measures (Fornell and Larcker, 1981). Finally, we assessed the discriminant validity of the measures by comparing the root values of the AVEs for each of the corresponding construct and the correlation coefficients between the construct and all the others in the model. The results revealed that the square root values of the AVEs for each construct were higher than the correlation coefficient values between the construct and all other constructs, which exhibited a strong discriminant validity of the measures used in the study (Table 2).

## 4.2. Hypotheses testing

We tested our hypotheses empirically by performing SEM analyses after confirming the validity of the measures. Figure 2 presents the results of the SEM estimations. Hypotheses 1 and 2 predicted that autonomy and environment agility of GSHPs had a positive effect on task-technology fit, respectively. As shown in Figure 2, a positive and statistically positive relationship existed among autonomy ($b = 0.192$, $p < 0.01$), environmental agility ($b = 0.121$, $p < 0.05$), and task-technology fit. These results provided support for Hypotheses 1 and 2. Relatedly, Hypotheses 3 and 4 proposed that the autonomy and environment agility of GSHPs had a positive effect on social-technology fit. The results reported in Figure 2 indicated a positive and statistically significant relationship between autonomy ($b = 0.135$, $p < 0.01$) and social-technology fit, thus supporting Hypothesis 3. However, the results showed a positive but statistically insignificant effect of environmental agility on social-technology fit ($b = 0.026$, $p > 0.05$). Thus, Hypothesis 4 was not supported. Then, Hypotheses 5 and 6

TABLE 1 Results of construct reliability and validity assessments.

| Construct and indicators | Mean | STD | Outer loading | Alpha | CR | AVE |
|---|---|---|---|---|---|---|
| Autonomy (ATM; Rokonuzzaman et al., 2022) | | | | 0.911 | 0.944 | 0.849 |
| ATM1: A green smart home product does not need a lot of human inputs to function. | 5.184 | 1.366 | 0.924 | | | |
| ATM2: A green smart home product works independently. | 4.997 | 1.352 | 0.922 | | | |
| ATM3: A green smart home product finds its own way. | 4.918 | 1.428 | 0.917 | | | |
| Environmental agility (EA; Rokonuzzaman et al., 2022) | | | | 0.881 | 0.926 | 0.807 |
| EA1: A green smart home product scans its environment. | 6.103 | 1.161 | 0.864 | | | |
| EA2: A green smart home product reacts to changes in the environment. | 5.752 | 1.282 | 0.919 | | | |
| EA3: A green smart home product directly adapts its behavior to the environment. | 5.867 | 1.164 | 0.910 | | | |
| Sense of belonging (SOB; Cheung and Lee, 2012) | | | | 0.930 | 0.955 | 0.877 |
| SOB1: If other GSHPs users planned something, I would think of as something "we" would do rather than something "they" would do. | 5.015 | 1.544 | 0.939 | | | |
| SOB2: I see myself as a part of the GSHPs system. | 4.764 | 1.468 | 0.935 | | | |
| SOB3: In general, GSHPs make me feel a sense of belonging. | 4.843 | 1.547 | 0.935 | | | |
| Self-actualization (SA; Phang et al., 2006) | | | | 0.925 | 0.952 | 0.869 |
| SA1: Using GSHPs gives me an opportunity for personal growth. | 4.864 | 1.561 | 0.927 | | | |
| SA2: Using GSHPs increases my feeling of self-fulfillment. | 4.804 | 1.395 | 0.938 | | | |
| SA3: Using GSHPs gives me a feeling of accomplishment. | 4.822 | 1.516 | 0.932 | | | |
| Task and technology fit (TTF; Lin and Huang, 2008; Zhou et al., 2010) | | | | 0.913 | 0.945 | 0.851 |
| TTF1: The functionalities of GSHPs were very adequate. | 5.450 | 1.344 | 0.919 | | | |
| TTF2: The functionalities of GSHPs were very sufficient. | 5.178 | 1.465 | 0.919 | | | |
| TTF3: In general, the functionalities of GSHPs were best fit the task. | 5.520 | 1.301 | 0.930 | | | |
| Social and technology fit (STF; Lu and Yang, 2014) | | | | 0.911 | 0.944 | 0.849 |
| STF1: In my opinions, GSHPs' functions are suitable for helping me complete my social situation. | 5.205 | 1.460 | 0.920 | | | |
| STF2: In my opinions, GSHPs are enough to help me complete my social situation. | 4.921 | 1.403 | 0.931 | | | |
| STF3: In my opinions, GSHPs are fit for the needs of my social situation. | 4.734 | 1.668 | 0.913 | | | |
| Purchase intention (PIN; Cui et al., 2021) | | | | 0.849 | 0.909 | 0.769 |
| PIN1: I often purchase GSHPs. | 4.746 | 1.677 | 0.836 | | | |
| PIN2: I plan to buy GSHPs. | 5.251 | 1.317 | 0.908 | | | |
| PIN3: I will buy GSHPs in the future. | 5.589 | 1.317 | 0.885 | | | |

$N = 331$. STD, Standard deviation; Alpha, Cronbach's alpha; CR, Composite reliability; AVE, average variance extract.

TABLE 2 Correlations and discriminant validity among the constructs.

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1. Autonomy | ***0.921*** | | | | | | |
| 2. Environmental agility | 0.190 | ***0.898*** | | | | | |
| 3. Sense of belonging | 0.290 | 0.307 | ***0.937*** | | | | |
| 4. Self-actualization | 0.486 | 0.319 | 0.628 | ***0.932*** | | | |
| 5. Task-technology fit | 0.463 | 0.361 | 0.633 | 0.653 | ***0.923*** | | |
| 6. Social-technology fit | 0.420 | 0.291 | 0.708 | 0.663 | 0.635 | ***0.922*** | |
| 7. Purchase intention | 0.530 | 0.370 | 0.610 | 0.700 | 0.658 | 0.654 | **0.877** |

N = 331. Figures in italicized bold denote the square root of the AVE of each study construct.

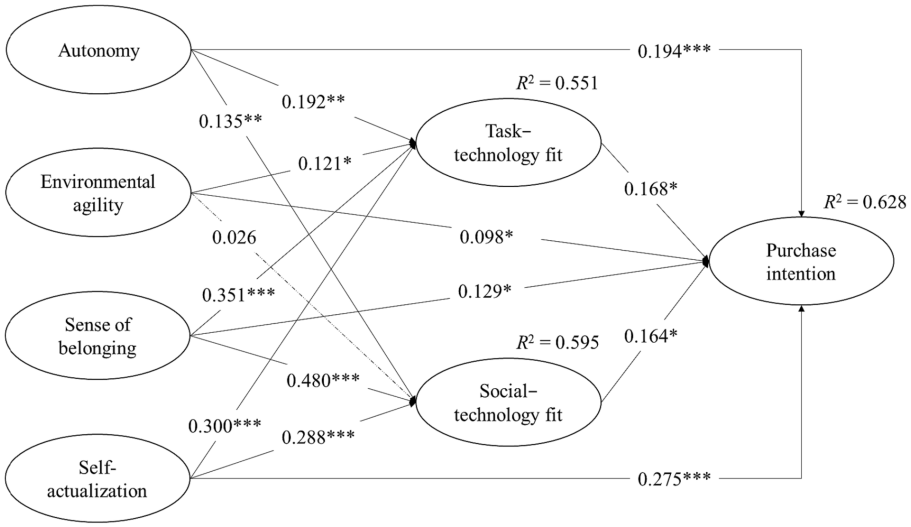


FIGURE 2
Results of the SEM estimations.

proposed that the autonomy and environment agility of GSHPs had a positive effect on purchase intention. As shown in Figure 2, these variables, including the autonomy ($b = 0.194$, $p < 0.001$) and environment agility ($b = 0.098$, $p < 0.05$) of GSHPs, exerted positive and significant influences on purchase intention. Thus Hypotheses 5 and 6 were supported. We examined Hypotheses 7 and 8 by estimating the effects of a sense of belonging and self-actualization on task-technology fit. The results presented in Figure 2 showed a positive and statistically significant relationship among sense of belonging ($b = 0.351$, $p < 0.001$), self-actualization ($b = 0.300$, $p < 0.001$), and task-technology fit. These results demonstrated respective support for Hypotheses 7 and 8. In Hypotheses 9 and 10, we hypothesized a positive effect of a sense of belonging and self-actualization on social-technology fit. As shown in Figure 2, a positive and statistically significant relationship existed between a sense of belonging ($b = 0.480$, $p < 0.001$), self-actualization ($b = 0.288$, $p < 0.001$), and social-technology fit. These results provided support for Hypotheses 9 and 10, respectively. Furthermore, Hypotheses 11 and 12 proposed that a sense of belonging, and self-actualization had a positive effect on purchase intention, which could be verified by the results in Figure 2. Sense of belonging ($b = 0.129$, $p < 0.05$) and self-actualization ($b = 0.275$, $p < 0.001$) had positive and significant influences on purchase intention, thus providing support for Hypotheses 11 and 12. In addition, we empirically examined Hypotheses 13 and 14, which proposed the effects of task-technology fit and social-technology fit on purchase intention, respectively. The results reported in Figure 2 showed that task-technology fit ($b = 0.168$, $p < 0.05$) and social-technology fit ($b = 0.164$, $p < 0.05$) had positive and statistically significant effects on purchase intention, thus supporting Hypotheses 13 and 14.

Finally, while it goes beyond the scope of our study, we raised the question of whether an indirect effect is exerted via task-technology fit or social-technology fit. Accordingly, we examined the potential indirect effects to supplement our analysis and report the results for indirect effects testing in Table 3. As shown in Table 3, we found a positive and statistically significant indirect effect of autonomy on purchase intention at a 10% level via task-technology fit ($b = 0.032$, $p < 0.10$) and social-technology fit ($b = 0.022$, $p < 0.10$). This outcome suggested a partial mediating effect of task-technology fit and social-technology fit on the relationship between autonomy and purchase intention (i.e., both direct and indirect effects of autonomy on purchase intention were positive and significant). We also found that sense of belonging has a positive and significant indirect effect on purchase intention at a 5% level via both task-technology fit ($b = 0.059$, $p < 0.05$) and social-technology fit ($b = 0.079$, $p < 0.05$). Given its positive and significant direct effect on purchase intention, these results also indicated a partial mediating effect of both task-technology

TABLE 3 Results of structural model estimation for indirect effects.

| Indirect effects | Estimates | *p* values |
|---|---|---|
| Autonomy → Task-technology fit → purchase intention | 0.032* | 0.065 |
| Autonomy → Social-technology fit → purchase intention | 0.022* | 0.080 |
| Environmental agility → Task-technology fit → purchase intention | 0.020 | 0.105 |
| Environmental agility → Social-technology fit → purchase intention | 0.004 | 0.603 |
| Sense of belonging → Task-technology fit → purchase intention | 0.059** | 0.026 |
| Sense of belonging → Social-technology fit → purchase intention | 0.079** | 0.032 |
| Self-actualization → Task-technology fit → purchase intention | 0.050* | 0.058 |
| Self-actualization → Social-technology fit → Purchase intention | 0.047** | 0.043 |

*$p < 0.10$.
**$p < 0.05$.

fit and social-technology fit on the relationship between a sense of belonging and purchase intention. Moreover, the results reported in Table 3 demonstrated a positive and significant indirect effect of self-actualization on purchase intention via task–technology fit ($b = 0.050$, $p < 0.10$) at the 10% level and social-technology fit ($b = 0.047$, $p < 0.05$) at the 5% level. Considering the positive and significant direct effect of self-actualization on purchase intention, these results demonstrated that task-technology fit and social-technology fit played an important role in partially mediating the effect of self-actualization on purchase intention. However, we found no significant indirect effect of environmental agility on purchase intention via either task-technology fit ($b = 0.020$, $p > 0.10$) or social-technology fit ($b = 0.004$, $p > 0.10$), thus providing no evidence of the mediating effect of either task-technology fit or social-technology fit in the relationship between environmental agility and purchase intention. We discuss the detailed results and their potential implications in the next section.

# 5. Discussion and conclusion

## 5.1. Discussion and implications for theory and practice

In this study, building upon the perspective of the hierarchy of needs and task-technology fit, we theorize and empirically explore how to promote the purchase intention of GSHPs by achieving a fit between the technology characteristics of GSHPs and consumers' needs. In doing so, we developed a theoretical model to specifically analyze how the alignment between the technology characteristics of GSHPs and consumers' needs influences consumption decision-making. We believe our study provides an important contribution to the literature by offering a fresh perspective on the application of the hierarchy of needs and task-technology fit theories. In particular, the integration of these two prominent theories in this study contributes to the literature on consumers' purchase intentions for GSHPs by offering a comprehensive perspective on the factors influencing consumer behavior in the context of sustainable and technologically advanced home solutions. We believe such theoretical synthesis enhanced our insights into the complex dynamics of consumer behavior and would help pave the way for more effective strategies in promoting sustainable and environmentally friendly technologies. Overall, our study provides several implications which can be summarized as follows.

First, this study finds that the autonomy of GSHPs has a positive impact on both task-technology fit and social-technology fit. However, environmental agility only has a positive impact on task-technology fit. Previous research has found that the autonomy and environmental agility of GSHPs have the potential to enhance consumers' user experience, improve interaction quality, and provide a platform for self-improvement (Cho and Kim, 2014). The current study extends these findings by demonstrating that the autonomy and environmental agility of GSHPs can improve task-technology fit. This result emphasizes the significance for manufacturing enterprises to improve the autonomy and environmental agility of GSHPs continuously. For example, the ability of smart objects must be enhanced to distinguish different dialects or accents to make accurate responses to users' commands from different regions and age groups. Moreover, the level of intelligent automation and the accuracy of inbuilt sensors for environment monitoring must be improved.

However, environmental agility does not have a positive impact on social-technology fit. A possible explanation for this result is that, while the autonomy of GSHPs implies an instant response, which allows users to provide real-time feedback based on instructions, environmental agility may require intelligent devices to scan, perceive, learn, and adapt to the environment before reacting (Rijsdijk and Hultink, 2009; Rokonuzzaman et al., 2022). This delay of gratification may affect consumers' attitudes toward smart home technology, and the satisfaction degree of social needs may be significantly reduced. Smart home manufacturers need to improve and innovate smart home technology continuously to enhance the capabilities of their products for information process and quick response to improve social-technology fit.

Second, the positive relationship between technology characteristics and consumers' purchase intention has also been

verified. Previous research has examined the mediating effects between autonomy and experience value, an antecedent of repurchase intention for smart products. However, it has denied the direct effect of autonomy on repurchase intention (Lucia-Palacios and Pérez-López, 2023). By contrast, this study provides statistical evidence for the direct effect and highlights the significance of technological enhancement.

Moreover, this study finds that consumers' needs for a sense of belonging and self-actualization have positive effects on task-technology fit and social-technology fit, respectively. It implies the importance for firms to pay attention to consumers' needs for belongingness and self-actualization when considering the fit among technology, tasks, and social demands. Firms need to connect additional devices and users to their intelligent platforms to increase the quantity and quality of interactions. Sense of belonging can be enhanced through interaction with their smart devices within their houses and through sharing information about the smart home devices with their relatives and friends (Lee et al., 2017).

More importantly, when consumers want to establish a better self-image or demonstrate a higher social status, they are likely to select unique products with high technology characteristics and engage in conspicuous consumption to satisfy their social needs (Gram-Hanssen and Darby, 2018). Some of these consumers may even sacrifice some benefits in price to satisfy their pursuit of a higher social status (Ramakrishnan et al., 2020). Inspired by this result, smart home enterprises can adopt different strategies for consumers with different levels of task needs and social needs. Marketers can also enhance buyers' green and environmentally friendly image through the promotion of the environmental performance of GSHPs so that more consumers may be attracted to increase their psychological needs by purchasing GSHPs.

In addition, the results also indicate a positive effect of a sense of belonging and self-actualization on consumers' purchase intention, which is highly in line with the previous findings (Hwang and Kim, 2018; Hawkins, 2020; Lebrument et al., 2021). Thus, the current study highlights the importance of satisfying consumers' needs.

Finally, this study confirms that task-technology fit and social-technology fit have a positive effect on consumers' purchase intentions for GSHPs, as emphasized by previous research (Lu and Yang, 2014; Ling et al., 2021). This study extends these findings by showing that task-technology fit and social-technology fit should be considered when firms promote consumers' purchase intentions for GSHPs. In the production and marketing process, enterprises should not only focus on the technology characteristics of GSHPs and the features of consumers' needs but also analyze the degree of fit among technology characteristics, tasks, and social needs of their consumers. A higher degree of fit can provide consumers with an optimal consumption experience, increase their purchase intention, and help enterprises improve their competitiveness and performance.

### 5.2. Limitations and future research directions

This study has certain limitations due to several factors, such as time, energy, and region. First, this study selected Chinese consumers as the research sample. However, the differences in technology level and consumers' demand for GSHPs in different countries may affect the universality of the research results. Further research can expand the research scope by studying consumers' purchase intention of GSHPs in different regions with various technological, economic, and cultural backgrounds (*cf.* Li et al., 2021). Second, previous studies have found that factors such as consumers' gender, social status, and education level may affect their acceptance of innovative technology products (Venkatesh et al., 2000; Cai et al., 2017; Shin et al., 2018). Therefore, future research can attempt to explore the impact of these factors on consumers' purchase behavior of GSHPs based on this study. Third, this study verifies the positive impact of the autonomy and environmental agility of GSHPs on purchase intention. Scholars have also identified other characteristics of smart products, such as anthropomorphism, cooperativeness, and connectivity (Rijsdijk and Hultink, 2009; Langley et al., 2021). Subsequent research can expand the research scope of the technology characteristics of GSHPs to obtain a comprehensive analysis of green purchase behavior for smart products.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

Ethical approval was not required for the studies involving humans in accordance with the national legislation and the institutional requirements. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

MG: Visualization, Conceptualization, Data curation, Investigation, Writing – original draft. SX: Conceptualization, Visualization, Formal analysis, Methodology, Supervision, Validation, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# Are non-competitors greener? The effect of consumer awareness differences on green food consumption

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**Introduction:** Green consumption plays a crucial role in mitigating environmental degradation. Governments and corporations are actively fostering the growth of green consumption. The escalating environmental issues have awakened consumers' environmental and competitive awareness, which significantly aids in increasing the probability of green food consumption.

**Methods:** This study, based on the Self-Consistency Theory and the Theory of Planned Behavior, constructs a model to analyze the effects of consumer competitive and environmental awareness on green food purchase intentions. Data from 700 consumer surveys were examined through structural equation modeling.

**Results:** Findings indicate that while consumer competitive awareness negatively impacts green self-efficacy and perceived control, environmental awareness has a positive effect. Green self-efficacy and perceived control both positively influence green food purchase intentions. Notably, competitive awareness has a more substantial negative impact on perceived control compared to green self-efficacy. In contrast, the positive influence of environmental awareness on green self-efficacy is stronger than on perceived control. Moreover, the effect of green self-efficacy on green food purchase intention is more pronounced than that of perceived control.

**Discussion:** Strategies like enhancing media publicity, educational initiatives, and improving purchase convenience can increase consumer purchase intentions. This study offers valuable insights for governments and businesses in understanding consumer psychology in green food consumption, aiding in marketing strategies for green food products.

KEYWORDS

**competitive awareness, environmental awareness, green self-efficacy, perceived control, green food purchase intention**

## 1 Introduction

The deterioration of the ecological environment is a global challenge, reminiscent of the tragedy of the commons in economics. For governments, reducing environmental pollution and carbon emissions is a critical issue (Guo et al., 2022). Individually, environmental problems affect people's quality of life, leading to a shift in consumers' green consumption awareness and attitudes (Yam-Tang and Chan, 1998). Human activities, such as industrial

emissions, transportation, agricultural activities, urban development, waste management, and consumption habits, are key drivers of many environmental issues (Schultz, 2011). Although studies have highlighted the impact of production and living behaviors on environmental problems, the specific mechanisms of improving environmental issues through personal consumption behaviors remain unclear.

Green food, defined by Zheng et al. (2022), refers to food produced in a healthy ecological environment, cultivated, processed, packaged, stored, and transported under strict standards with comprehensive quality control. It bears the green food label, meeting environmental, health, and social sustainability requirements, ensuring safety, quality, and pollution-free products. Promoting green food consumption can alleviate environmental problems caused by agricultural activities and food processing, ensuring consumer health. Similar to the tragedy of the commons, governments and businesses advocating green consumption can reduce environmental pollution from fertilizers and pesticides, lower carbon emissions, and decrease resource consumption. Promoting green consumption is key to achieving sustainable development for both the environment and businesses (Yan et al., 2021). For consumers, green food, compared to regular agricultural products, has lower levels of fertilizers, pesticides, and heavy metals, reducing the risk of food poisoning and ensuring health (Zheng et al., 2023). The concept of individual rights in the tragedy of the commons suggests that consumer choices can impact the health of public resources. Therefore, advocating for the consumption of green food is a way for individuals to contribute to the common good of society. However, the specifics of how consumer behavior can promote the prevalence of green food and environmental sustainability require further in-depth study.

The strength of consumer awareness can enhance the likelihood of green food consumption (Le et al., 2022). Environmental degradation can trigger two types of consumer awareness: first, a protective awareness toward the environment on which they depend (Janmaimool and Chudech, 2020). As concerns about climate change, water scarcity, and biodiversity loss grow, along with government advocacy, consumers are becoming increasingly aware of issues related to water sources, land pollution, and air quality. Motivated by their health and quality of life, they are inclined to purchase green foods. This is because green foods emphasize environmental protection during production, processing, and storage, thereby reducing pollution of air, land, and water resources. Second, a competitive awareness toward environmental resources (Fritze et al., 2008), as conceptualized in the tragedy of the commons, where public resources are overused or encroached upon competitively, leading to resource depletion. On one hand, higher consumer competitive awareness may reduce interest and motivation in purchasing green food. In contexts of environmental degradation and resource scarcity, competitive thinking is activated (Roux et al., 2015), with consumers focusing more on cost, price, and durability (Zhu et al., 2018), and neglecting the green attributes of products due to perceived poor cost-effectiveness. On the other hand, as consumer environmental awareness increases, more consumers start valuing the importance of green purchasing (Lin and Huang, 2012), focusing on food quality and safety, and recognizing the benefits of green food for health and the environment (Zheng et al., 2023). Current research primarily focuses on consumer cognition regarding environmental protection and resource competition, with the specific impact of consumer awareness on green food consumption behavior remaining unclear.

Research on the factors influencing green consumption willingness can be categorized into three parts. First, demographic characteristics, including gender, age, education level, etc. (Chekima et al., 2016; Alzubaidi et al., 2021), where studies find women are more likely to adopt green consumption behaviors, while marital status is unrelated to environmental attitudes (Diamantopoulos et al., 2003). Second, external environmental factors, including price, labeling, government, advertising, etc. (Zheng et al., 2022; Hu and Meng, 2023; Lu and Li, 2023). Third, psychological factors, including consumer attitudes, cognition, knowledge, and environmental concerns (Meinhold and Malkus, 2005; Pagiaslis and Krontalis, 2014; Zheng et al., 2023).

While these studies lay the foundation for research on green consumption behaviors, they fail to comprehensively analyze consumer behavior from the perspective of facing environmental and competitive challenges. Existing research lacks a comprehensive analysis of consumer awareness, especially from the perspective of competitive awareness, on green consumption behavior. This study aims to fill this research gap, exploring how competitive awareness and environmental awareness jointly influence consumers' green food purchase decisions. Scholarly research on competitive awareness has primarily focused on interpersonal behaviors, such as willingness to cooperate (Van Lange, 1999), willingness to contribute (Van Lange et al., 1997), and social comparison behaviors (Stapel and Koomen, 2005). Notably, both competitive awareness and environmental awareness play significant roles in green consumption willingness research. Competitive awareness can stimulate a competitive mindset in consumers, driving them toward green products to showcase their environmental concerns and social responsibility. Additionally, environmental awareness reflects consumers' understanding and cognition level of environmental issues, guiding the entire purchasing decision process, and thus influencing their consumption of green food.

This study aims to bridge this gap by constructing a theoretical model of the impact of consumer awareness (environmental and competitive awareness) on green food consumption. Based on the Self-Consistency Theory and the Theory of Planned Behavior (TPB), this research will delve into how consumers balance competitive awareness and environmental awareness in decision-making processes involving environmental and social responsibilities. This endeavor seeks to enrich research on green consumption behaviors, providing references for governments and businesses to further unleash the potential of green consumption.

# 2 Research hypotheses and theoretical framework

## 2.1 Research hypotheses

### 2.1.1 Competitive awareness and green self-efficacy

Competitive awareness refers to an individual's desire and psychological inclination to achieve personal success, enhance potential, and fulfill personal goals (Roux et al., 2015). Green

self-efficacy denotes an individual's confidence and capability to undertake pro-environmental actions, i.e., self-assessment of achieving environmental protection goals (Meinhold and Malkus, 2005). Consumers' competitive awareness can lead to a focus on immediate personal benefits while overlooking long-term environmental impacts, weakening their green self-efficacy.

In decision-making, competitive awareness may prompt excessive focus on personal gain, intensifying selfish behavior. In social contexts, competitive awareness might drive seemingly altruistic behavior, albeit still grounded in self-interest (Roux et al., 2015). Excessive competitive awareness can lead to egocentrism, neglecting others' needs, future personal requirements, and potential environmental impacts. This may result in consumers prioritizing personal gain over eco-friendliness and sustainability, potentially leading to unethical or self-serving behaviors (Van Lange, 1999). In this context, consumers may purchase unnecessary and low-quality goods, thereby exacerbating environmental burdens, while also neglecting their social responsibility regarding environmental issues. This leads to a decline in green self-efficacy.

For instance, panic buying triggered by the pandemic can have negative societal impacts (Chua et al., 2021). This situation fosters a competitive mindset among consumers over existing resources, leading to over-purchasing of goods and essentials. Such behavior results in resource wastage and can cause excessive greenhouse gas emissions (Pappalardo et al., 2020), intensifying environmental strain. In this scenario, consumers prioritize ensuring that the products they purchase meet sanitary standards, often overlooking their environmental impact. This focus can diminish their motivation to actively address environmental issues, subsequently reducing their green self-efficacy.

Based on this analysis, we propose:

**H1:** Consumer competitive awareness negatively impacts green self-efficacy.

### 2.1.2 Competitive awareness and perceived control

Perceived control refers to the consumer's sense of having power and decision-making authority in their purchasing behavior. However, this perceived control can be influenced by a consumer's competitive awareness. Competitive awareness leads consumers to focus more on comparisons with others (Stapel and Koomen, 2005), resulting in increased self-awareness and hostility toward others, thereby reducing the spirit of cooperation (Van Lange et al., 1997). A strong competitive awareness can negatively impact the consumer's psychology, such as questioning their abilities or actions, leading to a decline in self-confidence and, consequently, reduced perceived control.

Under the influence of competitive awareness, consumers may make unsuitable consumption decisions. Time pressure (Dambacher et al., 2011) can lead to impulsive purchasing (Zhang and Zhang, 2022), neglecting real needs and quality, affecting perceived control. Additionally, competitive awareness can induce stress and anxiety during purchasing. This is because competitive awareness makes consumers perceive the scarcity of goods, leading them to believe in supply chain disruptions and instability in their surrounding environment, which increases their sense of loss of control (Bonneux and Van Damme, 2006; Chua et al., 2021).

In summary, competitive awareness can negatively impact consumers' perceived control. On one hand, it can weaken this perceived control by inducing impulsive buying and reducing self-confidence. On the other hand, competitive awareness can cause consumers to feel the instability of supply chains during the purchasing process, thus affecting their control over purchasing decisions.

Based on this analysis, we propose:

**H2:** Consumer competitive awareness negatively impacts perceived control.

### 2.1.3 Environmental awareness and green self-efficacy

Consumer environmental awareness refers to the recognition and concern for environmental issues and the willingness to strive for ecological solutions (Dunlap and Jones, 2002). This awareness is not only reflected in the recognition of environmental issues but also in the attitude of consumers toward taking action to protect the environment. Green self-efficacy refers to an individual's confidence and sense of ability to engage in environmentally friendly behaviors (Meinhold and Malkus, 2005). Higher environmental awareness helps consumers understand green food and its environmental benefits (Lin and Chang, 2012), like standards and mechanisms, and the positive role in reducing environmental pollution, making consumers more willing to make efforts to alleviate ecological and environmental issues.

Consumers with strong environmental awareness are more likely to recognize the impact of their actions on the environment and engage in green behaviors, like choosing eco-friendly hotels, cars (Okada et al., 2019), and organic food (Basha et al., 2015). These behaviors not only reflect the consumers' attitude toward environmental protection but also demonstrate their ability to achieve green goals through practical actions. Therefore, these actions, in turn, enhance their sense of green self-efficacy, which is the recognition of their confidence and ability to carry out environmentally friendly behaviors.

Furthermore, the greater the attention to environmental issues, the higher the consumers' regard for ecological sustainability, leading to the formation of a more positive attitude toward environmental protection (Wang et al., 2020). Studies have shown that environmental awareness can positively influence attitudes, subjective norms, and perceived behavioral control (Xu et al., 2020). This heightened awareness helps consumers to gain a more comprehensive understanding of environmental knowledge and skills, thereby changing their mindset and perceptions toward adopting green technologies' cognitive values, i.e., from their attitudes (environmental awareness) to influencing their perceived efficiency of behavior (self-efficacy) (Jiang et al., 2022).

Based on this analysis, we propose:

**H3:** Consumer environmental awareness positively influences green self-efficacy.

### 2.1.4 Environmental awareness and perceived control

According to the TPB, environmental awareness positively impacts consumers' perceived behavioral control (Xu et al., 2020). Consumers' negative environmental behaviors may stem from a lack of awareness about environmental issues. Increased environmental awareness can help consumers recognize their impact on the environment and contribute to its mitigation (Wang et al., 2023). When consumers are more aware and concerned about environmental issues, they are more capable of realizing that their purchasing behavior can impact the environment, thereby becoming more motivated to engage in green consumption (Slamet et al., 2016). This positive shift in behavior can enhance consumers' sense of self-control, enabling them to take environmentally friendly actions with greater confidence.

For consumers with high environmental awareness, their environmental knowledge and eco-friendly skills can further enhance their self-efficacy related to the environment. Consumers equipped with such abilities are more adept at obtaining and discerning information about green products, leading to more accurate purchasing decisions or contributing to environmental protection through actions like recycling and reuse (Ruangkanjanases et al., 2020). This enhancement of abilities helps to strengthen their control over purchasing behavior, making consumers feel effectively in charge of their actions, thus boosting their perceived control.

Based on this analysis, we propose:

**H4:** Consumer environmental awareness positively influences perceived control.

### 2.1.5 Green self-efficacy and green food purchase intention

According to the Self-Consistency Theory, strong green self-efficacy, the belief in one's ability to engage in eco-friendly behavior, can translate into a stronger willingness to protect the environment (Hu and Meng, 2023), including purchasing green food, as consumers believe it benefits both personal health and the environment.

The Theory of Reasoned Action suggests that perceived efficacy in one's actions is a key predictor of behavioral intentions (Schifter and Ajzen, 1985). Studies have found that stronger perceived behavioral efficiency (e.g., farmers' self-efficacy) is closely linked to increased behavioral intentions (e.g., willingness for low-carbon production) (Jiang et al., 2022). Consumers with higher green self-efficacy, believing in their ability to achieve environmental goals through purchasing green food, are more likely to be motivated to consume green food.

After engaging in green consumption, if consumers gain positive experiences and effects from consuming green foods, such as improved health and increased environmental awareness (Zheng et al., 2023), this will enhance their willingness to continue purchasing green foods, thereby further boosting their intention to consume green foods. Related studies also indicate that green self-efficacy promotes the generation of pro-environmental behaviors in individuals (Jansson et al., 2010).

Based on this analysis, we propose:

**H5:** Consumer green self-efficacy positively influences green food purchase intention.

### 2.1.6 Perceived control and green food purchase intention

Perceived behavioral control theory posits that an individual's perception of control significantly predicts their behavioral intentions (Adnan et al., 2019). Studies show that perceived behavioral control positively impacts the willingness to purchase green products (Xu et al., 2020). In that study, perceived behavioral control refers to the consumers' perception that they have the time, money, and ability to purchase green products, and the stronger this perceived control, the higher their behavioral intention (Wang et al., 2016). Perceived control can manifest as an assessment of the convenience of purchasing specific products (like recycled electronics), directly enhancing purchasing intentions (Yu et al., 2021). Perceived control, as a form of perceived behavioral control, represents an individual's assessment of resources and opportunities for specific behaviors, including consumers' sense of capability and obstacles in specific purchasing decisions (Choi and Park, 2017). When consumers feel effective control and decision-making in purchasing, they are more likely to lean toward green consumption. Conversely, difficulties or a sense of loss of control may hinder their engagement in eco-friendly actions (Wong et al., 2021).

Based on this analysis, we propose:

**H6:** Consumer perceived control positively influences the green food purchase intention.

## 2.2 Theoretical framework

Grounded in the Self-Consistency Theory, consumers are motivated toward products that align with their personal goals, which strengthens their psychological identification and actively encourages them to purchase that product (Sirgy, 1982). Specifically, when consumers' environmental awareness is effectively exhibited, it leads to consistent cognitive processing. This promotes a perspective that considers ecological aspects, stimulating green self-efficacy and belief in their ability to mitigate environmental issues, thereby adopting green consumption behaviors (Lin and Hsu, 2015).

According to the TPB, an individual's behavioral attitudes, subjective norms, and perceived behavioral control influence their behavioral intentions (Ajzen, 1991). In the context of green consumption, consumers' behavioral attitudes can be seen as their attitudes/awareness toward green consumption. Perceived behavioral control can be interpreted as consumers' perceived control and green self-efficacy, and individual behavioral intentions as consumers' green food purchase intention.

Based on the above analysis, a theoretical model of consumer awareness influencing green food purchase intention is constructed, as shown in Figure 1.

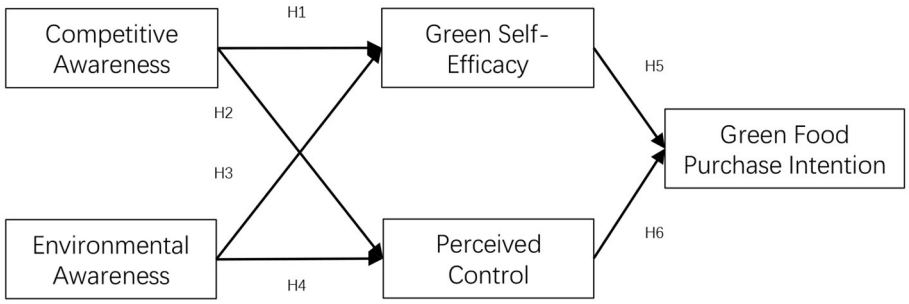


FIGURE 1
Theoretical model of the influence of consumer awareness on the green food purchase intention.

TABLE 1 Measurement items.

| Variables | Indicators | Items | References |
|---|---|---|---|
| Competitive awareness (CA) | CA 1 | I get jealous when my competitors are rewarded for their achievements | Ryckman et al., 1990 |
| | CA 2 | When I lose in a competition, I get sad | |
| | CA 3 | I can't stand to lose in an argument | |
| | CA 4 | Losing in the competition will make me feel inferior to others | |
| Environmental awareness (EA) | EA 1 | I am concerned about environmental pollution | Pagiaslis and Krontalis, 2014 |
| | EA 2 | I am concerned about air and water pollution in the city | |
| | EA 3 | I am concerned about the waste of water in the city | |
| | EA 4 | I consider the impact on the environment when I buy products | |
| Green self-efficacy (GSE) | GSE 1 | I think I can successfully practice the concept of environmental protection | Chen et al., 2001 |
| | GSE 2 | I feel I have the ability to help achieve environmental goals | |
| | GSE 3 | I think I can effectively fulfill my environmental mission | |
| | GSE 4 | I feel I am capable of dealing effectively with environmental issues | |
| | GSE 5 | I think we can find creative solutions to environmental problems | |
| Perceived control (PC) | PC 1 | Anything I'm determined to do, I can almost always do | Lachman and Weaver, 1998 |
| | PC 2 | If I really want to do something, I can usually find a way to succeed | |
| | PC 3 | Whether I get what I want is within my control | |
| | PC 4 | What my future will be depends mainly on me | |
| Green food purchase intention (GPI) | GPI 1 | I consider buying green food | Zheng et al., 2023 |
| | GPI 2 | I am willing to buy green food if needed | |
| | GPI 3 | Green food will excite me to buy | |
| | GPI 4 | I think green food is worth buying | |

# 3 Methods

## 3.1 Questionnaire design

The research survey is divided into three parts: an introductory statement, a measurement of the main variables, and the respondents' basic information. First, the introduction primarily explains the purpose of the survey and assures confidentiality to alleviate any concerns of the respondents. Second, the measurement of the main variables includes five elements: competitive awareness, environmental awareness, green self-efficacy, perceived control, and green food purchase intention (the scales are shown in Table 1). The variables in this study were adapted from mature scales developed by previous scholars and measured using a 7-point Likert scale. The scale for competitive awareness is based on Ryckman et al. (1990)'s work, environmental awareness on Pagiaslis and Krontalis (2014), green self-efficacy on Chen et al. (2001), perceived control on Lachman and Weaver (1998), and green food purchase intention on Zheng et al. (2023). Third, the basic

TABLE 2 Sample characteristics.

| Item | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 268 | 38.3% |
| Female | 432 | 61.7% |
| **Age** | | |
| 18–22 | 98 | 14.0% |
| 23–30 | 359 | 51.3% |
| 31–40 | 188 | 26.9% |
| 41–50 | 36 | 5.1% |
| Above 51 | 19 | 2.7% |
| **Education** | | |
| High school or below | 15 | 2.1% |
| Junior college | 52 | 7.4% |
| Bachelor | 520 | 74.3% |
| Master degree or above | 113 | 16.1% |
| **Monthly income** | | |
| 4,000 RMB or below | 155 | 22.1% |
| 4,001–8,000 RMB | 242 | 34.6% |
| 8,001–12,000 RMB | 202 | 28.9% |
| 12,000 RMB or above | 101 | 14.4% |

information section includes gender, age, education level, and income.

## 3.2 Sample analysis

The study included two screening questions to ensure the reliability and attentiveness of the respondents. The first question, "Have you ever purchased green food?", was used to identify valid samples, with only those responding "Yes" considered. The second, "Which of the following is a marine animal?", was designed to ensure respondent attentiveness. In December 2022, the study distributed an online survey through the Credemo platform, widely recognized in the fields of consumer behavior and psychology. The platform first automatically excluded respondents who did not answer the second screening question seriously. Researchers then manually excluded invalid samples based on the first question. A total of 700 valid responses were collected, covering all provinces of China.

The demographic characteristics of the sample are shown in Table 2. The majority of the respondents were female (61.7%), aligning with the typical role of women in Chinese families as food purchasers and similar to previous green food research (Xu et al., 2022a). Most respondents were middle-aged and young adults (78.2%), which may be due to their deeper exposure to green food. A high level of education was observed (61.7% with a bachelor's degree or higher), possibly because green food companies find it less costly to disseminate information about green food to this demographic, who are more receptive to it, similar to previous findings (Zheng et al., 2023). The sample included a significant proportion of high-income earners, indicating the economic capability to purchase green food, consistent with the research objective and previous studies (Zheng et al., 2022).

# 4 Results

## 4.1 Reliability and validity analysis

The PLS-SEM analysis was conducted using SMARTPLS 3.0 software. The reliability results are presented in Table 3. The Cronbach's Alpha values for all five variables exceeded the critical threshold of 0.6, the Rho_A values were >0.7, and the Composite Reliability values surpassed 0.8. These results indicate that the scales demonstrate good internal consistency, affirming the reliability of the scales (Hair et al., 2011).

Discriminant validity refers to the degree to which a variable is distinct from other variables. The study employed the Fornell-Larcker criterion to assess discriminant validity. According to Fornell and Larcker (1981) standards, the correlation coefficients between dimensions should be less than the Average Variance Extracted (AVE), meaning the values below the diagonal should be smaller than those on the diagonal. The discriminant validity of the study, as shown in Table 4, meets the Fornell-Larcker criterion, indicating good discriminant validity.

## 4.2 Assessment of structural model

The PLS-SEM analysis was performed using SMARTPLS 3.0 software. Initially, the PLS algorithm was employed to calculate the path coefficient values for each relationship, followed by the application of Bootstrapping to assess the significance of these path coefficients, with a subsample size set to 5,000. Path coefficients are considered significant when the $t$-value exceeds 1.96, and the $p$-value is <0.05. The research results, presented in Table 5, indicate that all hypotheses were supported, with corresponding path coefficients meeting the specified criteria.

From the perspective of path coefficients (Figure 2), the negative impact of competitive awareness on the perceived control is greater than its impact on green self-efficacy. The positive influence of environmental awareness on green self-efficacy exceeds its impact on perceived control. Additionally, the positive effect of green self-efficacy on the willingness to consume green products is greater than that of the perceived control.

## 4.3 Indirect effects testing

The study analyzed indirect and mediating effects through the assessment of total indirect effects and specific indirect effects. The results are depicted in Tables 6, 7. The findings show that all indirect effects are significant, with $t$-values exceeding 1.96 and $p$-values below 0.05.

TABLE 3 Reliability and validity analysis.

| Constructs | Item | Loadings | Cronbach's $\alpha$ | Rho_A | CR | AVE | VIF |
|---|---|---|---|---|---|---|---|
| CA | CA 1 | 0.832 | 0.840 | 0.864 | 0.891 | 0.673 | 1.779 |
| | CA 2 | 0.838 | | | | | 1.878 |
| | CA 3 | 0.733 | | | | | 1.676 |
| | CA 4 | 0.874 | | | | | 2.226 |
| EA | EA 1 | 0.820 | 0.792 | 0.797 | 0.865 | 0.616 | 1.741 |
| | EA 2 | 0.745 | | | | | 1.472 |
| | EA 3 | 0.780 | | | | | 1.628 |
| | EA 4 | 0.792 | | | | | 1.554 |
| GSE | GSE 1 | 0.781 | 0.842 | 0.845 | 0.887 | 0.612 | 1.682 |
| | GSE 2 | 0.801 | | | | | 1.923 |
| | GSE 3 | 0.790 | | | | | 1.749 |
| | GSE 4 | 0.816 | | | | | 2.043 |
| | GSE 5 | 0.721 | | | | | 1.540 |
| PC | PC 1 | 0.842 | 0.832 | 0.833 | 0.888 | 0.665 | 2.089 |
| | PC 2 | 0.832 | | | | | 1.878 |
| | PC 3 | 0.827 | | | | | 1.937 |
| | PC 4 | 0.759 | | | | | 1.512 |
| GPI | GPI 1 | 0.795 | 0.809 | 0.817 | 0.874 | 0.634 | 1.733 |
| | GPI 2 | 0.771 | | | | | 1.666 |
| | GPI 3 | 0.802 | | | | | 1.577 |
| | GPI 4 | 0.818 | | | | | 1.712 |

TABLE 4 Discriminant validity (FORNELL).

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Competitive awareness (1) | 0.821 | | | | |
| Environmental awareness (2) | −0.219 | 0.785 | | | |
| Green self-efficacy (3) | −0.312 | 0.724 | 0.783 | | |
| Perceived control (4) | −0.346 | 0.499 | 0.638 | 0.816 | |
| Green food purchase intention (5) | −0.153 | 0.661 | 0.622 | 0.481 | 0.796 |

# 5 Research conclusions and management implications

## 5.1 Conclusions

The study, grounded in the Self-Consistency Theory and the Theory of Planned Behavior, constructs a model examining the impact of consumer competitive awareness and environmental awareness on the intention to consume green food. Using a sample of 700 green food consumers and employing structural equation modeling for analysis, it was found that consumer competitive awareness negatively impacts green self-efficacy and perceived control. Conversely, consumer environmental awareness positively influences green self-efficacy and perceived control. Moreover, both green self-efficacy and perceived control positively affect the intention to consume green food.

## 5.2 Discussion

The finding that competitive awareness significantly negatively impacts green self-efficacy and perceived control differs from previous research, which primarily focused on panic buying behavior (Singh et al., 2023), aggressive behavior (Stapel and Koomen, 2005), and self-interest actions (Roux et al., 2015), or viewed competitive awareness mainly as a moderating factor (Song et al., 2021). Few studies have delved into how competitive awareness affects green self-efficacy and perceived control, possibly due to its complex psychological nature involving cognition, self, and adaptability (Mildawani et al., 2022). This study uniquely analyzes the consumer awareness sub-dimension - competitive awareness from the perspective of negative resource competition caused by environmental issues.

The significant positive impact of environmental awareness on green self-efficacy and perceived control also differs from previous research, which mainly focused on direct effects like purchasing intentions (Hao and Chenyue, 2021), learning strategies (Newton et al., 2015), environmental attitudes

TABLE 5 Model path coefficients.

| | β | Mean | SD | t-value | p-value | 95% LLCI | 95% ULCI | Decision |
|---|---|---|---|---|---|---|---|---|
| CA ->GSE | −0.161 | −0.161 | 0.023 | 7.100 | 0.000 | −0.199 | −0.123 | Supported |
| CA ->PC | −0.248 | −0.249 | 0.029 | 8.460 | 0.000 | −0.297 | −0.200 | Supported |
| EA ->GSE | 0.689 | 0.689 | 0.026 | 26.075 | 0.000 | 0.644 | 0.731 | Supported |
| EA ->PC | 0.445 | 0.446 | 0.036 | 12.411 | 0.000 | 0.386 | 0.505 | Supported |
| GSE ->GPI | 0.532 | 0.535 | 0.061 | 8.732 | 0.000 | 0.434 | 0.632 | Supported |
| PC ->GPI | 0.142 | 0.140 | 0.063 | 2.272 | 0.023 | 0.037 | 0.243 | Supported |

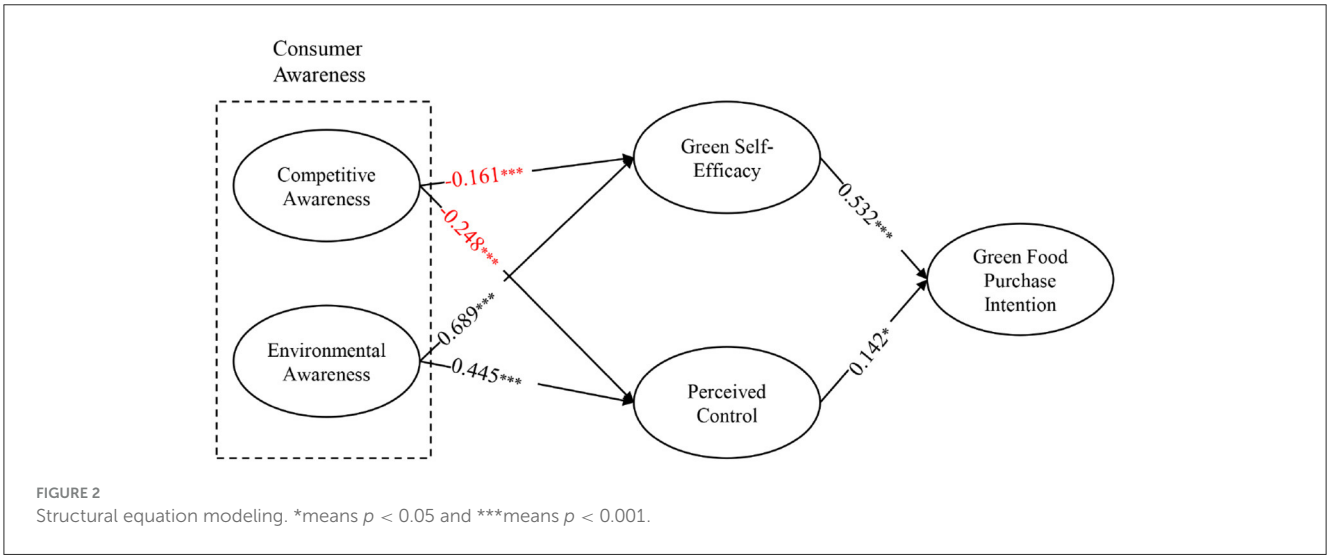


FIGURE 2
Structural equation modeling. *means $p < 0.05$ and ***means $p < 0.001$.

(Leclercq-Machado et al., 2022), and willingness to pay a premium (Konuk, 2018). There has been limited exploration into how environmental awareness influences green self-efficacy and perceived control. The impact mechanism varies due to the differing interpretations of environmental awareness (also termed ecological awareness, green awareness, environmental literacy, and environmental attitudes) in consumer behavior.

The study also finds that green self-efficacy and perceived control significantly positively influence green food consumption intentions, diverging from previous research focusing on personal characteristics, consumer cognition, attention, trust, motivation, and purchasing atmosphere (Alzubaidi et al., 2021; Ma et al., 2022; Zheng et al., 2023). There are relatively few studies focusing on how green self-efficacy and perceived control significantly influence the intention to consume green food.

Moreover, studies have shown that perceived behavioral control does not significantly affect low-carbon product purchasing intentions (Li et al., 2017), contrasting with our findings, possibly due to different decisive factors in purchasing various products and regional differences (Yu et al., 2021).

TABLE 6 Total indirect effect.

| | β | Mean | SD | t-value | p-value |
|---|---|---|---|---|---|
| CA->GPI | −0.121 | −0.121 | 0.016 | 7.497 | 0.000 |
| EA ->GPI | 0.430 | 0.432 | 0.033 | 13.111 | 0.000 |

TABLE 7 Specific indirect effects.

| | β | Mean | SD | t-value | p-value |
|---|---|---|---|---|---|
| CA -> GSE -> GPI | −0.085 | −0.086 | 0.015 | 5.664 | 0.000 |
| CA -> PC-> GPI | −0.035 | −0.035 | 0.016 | 2.218 | 0.027 |
| EA -> GSE -> GPI | 0.366 | 0.370 | 0.051 | 7.132 | 0.000 |
| EA -> PC-> GPI | 0.063 | 0.063 | 0.030 | 2.143 | 0.032 |

## 5.3 Theoretical contributions

First, the study categorizes consumer awareness into environmental and competitive awareness awareness, enhancing the scope of consumer awareness research. Previous studies primarily analyzed consumer altruism and self-interest, categorizing it into environmental, component, health, and food safety awareness (Bornkessel et al., 2014; Hojnik et al., 2019; Xu et al., 2022b), with different environmental awareness leading to varied green product preferences (Kanchanapibul et al., 2014). These studies primarily analyze the direct impact of consumer positive awareness on consumption from the perspective of consumer awareness (Hwang, 2016) or focus on a single dimension

in analyzing consumer behavior. There is less emphasis on examining the indirect effects of consumer awareness from different dimensions. This paper, by incorporating competitive awareness from a negative perspective of consumers, further refines consumer awareness theories and models, enhancing their explanatory power. It adds an explanation of the negative effects of green consumption, providing a more comprehensive understanding of consumer behavior in this context.

Second, the study provides a new research model for the impact of different dimensions of consumer awareness on consumption intentions and enriches the research on mediating variables between consumer awareness and consumption intentions. Previous mediator variable research included product familiarity, environmental responsibility, attitudes, subjective norms, perceived behavioral control, learning strategies, etc. (Newton et al., 2015; Hojnik et al., 2019; Zhang and Luo, 2021). The mechanisms of influence in this area exhibit a certain complexity and lack a unified understanding. Additionally, there is a scarcity of research focusing on green self-efficacy and perceived control as mediating variables. While some studies have analyzed the impact of self-efficacy on consumption intentions, these have primarily been conducted from perspectives such as self-monitoring, self-esteem, personal preferences, financial scarcity, anxiety, digital literacy, and other similar aspects (Lin and Hsu, 2015; Hu and Meng, 2023; Zhang et al., 2023). Limited research has analyzed the impact of perceived control on consumption intentions. However, these studies have primarily approached the topic from perspectives such as perceived risk, the severity of pandemics, crisis of product hazards in industries, perceived economic liquidity, and socioeconomic status (Yoon and Kim, 2018; Li et al., 2019; Zhang and Luo, 2021).

Additionally, some research suggests environmental awareness is challenging to translate into consumer behavior, or it only plays a moderating role in consumption intentions (De Canio et al., 2021). This study delves into the impact mechanisms of consumer awareness, green self-efficacy, perceived control, and green consumption intentions, highlighting the strong mediating role of green self-efficacy and its importance in influencing consumer purchasing decisions, enriching the research on green self-efficacy.

## 5.4 Management implications

### 5.4.1 Increase awareness through media and educational programs

Begin with school education, enhancing the dissemination of green environmental knowledge through textbooks, conferences, and educational campaigns, cultivating environmental awareness among students and teachers.

On one hand, efforts can be made to strengthen consumer education about environmental issues through various channels such as media (TV ads, Weibo, TikTok, Bilibili, promotional brochures, etc.), communities, and environmental organizations. This would help consumers become aware of the current environmental situation, like soil and water pollution, and realize the importance and urgency of protecting the environment. On the other hand, media can be used to inform consumers about the characteristics, production methods, transportation, labeling, and benefits of green foods. Enhancing consumer knowledge and understanding of the environmental benefits of green foods can make them more aware of the impact their green food consumption has on the environment and society, thereby increasing their perceived control.

### 5.4.2 Reduce consumer competitive awareness by improving purchase convenience and comfort

Enhance the convenience of purchasing green food. Businesses can increase sales channels for green food (online official stores, individual broadcasters, offline supermarkets, convenience stores), expand sales scope, and diversify product categories (primary green food, processed green food—green dried fruits and vegetables, gluten-free green food, low-fat green food, etc.), making it easier for consumers to access various types of green food and reducing the likelihood of choosing ordinary food due to competition.

Create a relaxing and enjoyable marketing atmosphere for consumers through the harmonious and comfortable design of online green food platforms, the selection of broadcasters, and the creation of self-service shared offline stores, reducing consumers' competitive mentality.

### 5.4.3 Enhance consumer control through communication forums and green food recognition mechanisms

Green food companies can establish forums for green food discussions, providing channels for consumer feedback (such as tea forums, and academic discussion forums), allowing consumers to learn about the benefits of green food (product quality, safety, health benefits), and encouraging purchases.

Build green food recognition mechanisms, allowing consumers to adopt green food cultivation areas and choose whether to participate in offline planting and sales or cloud adoption and involvement in green food planting or sales. This provides consumers with opportunities to join green food production and sales organizations, allowing them to participate more directly in the production and sales of green food and enhance their perceived control.

### 5.4.4 Enhance green self-efficacy through experiential activities, consumption guides, and role models

Organize experiential activities and publish guides for green food consumption to help consumers build confidence in green consumption, thereby improving their green self-efficacy.

Promoting environmental public welfare activities, as well as businesses and individuals who have contributed to environmental protection, can serve as role models to inspire consumers to choose green foods. Making consumers aware of those with a good reputation and positive word-of-mouth in the environmental field can increase trust in green foods through the demonstration effect, thereby enhancing green self-efficacy. Highlighting these positive examples can effectively motivate consumers by showing

the tangible impact of choosing environmentally friendly options and recognizing the efforts of those leading the way in sustainable practices.

### 5.5 Research limitations and future directions

Limitations of the study sample. Since the survey was conducted in a single month in China, there may be national economic and cultural differences, as well as quarterly consumption variations. Future research could explore green food consumption from different national perspectives, cultural viewpoints, quarterly aspects, or before and after government policy implementation.

Boundary Conditions Undiscussed. The study did not discuss the moderating variables affecting green consumption. Currently, there are many influencing factors, and boundary conditions have not been further discussed. Current research primarily focuses on individual-level variables. Future studies could explore boundary conditions of green food consumption behavior from group-level (group pressure) and organizational-level (environmental organization consumption habits) perspectives.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

Ethical review and approval was not required for the study of animals/human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/ participants or patients/participants legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## Author contributions

MZ: Conceptualization, Methodology, Writing—original draft. QZ: Resources, Supervision, Writing—review & editing. JC: Writing—review & editing. DT: Formal analysis, Supervision, Writing—review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# The impact of context cues on college students' purchase behavior for low-carbon products in CBEC

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**Introduction:** The purpose of this study was to examine the effects of online shopping context cues (price discount, carbon label, and social commentary) on college students' trust/perceived risk and cross-border purchase intention (CBPI) for low-carbon products and compare the study between South Korean and Chinese college students. The theoretical framework is established by integrating the S-O-R model and valence framework. The variable of stimuli (S) is the driving force in the purchase behavior that influences the individual organism (O) and its subsequent response (R). Based on this logic, this study draws on the valence framework to hypothesize the effects of online shopping context cues (price discount, carbon label, and social commentary) on college students' trust/perceived risk and cross-border purchase intention (CBPI) for low-carbon products.

**Methods:** This study conducted two online experiment-questionnaire studies and one between-subject lab experiment to test the hypotheses.

**Results:** We found that all three context cues have significant positive effects on trust and negative effects on perceived risk. College students' trust positively and perceived risk negatively impact college students' CBPI for low-carbon products. In addition, based on different cultures, languages, and education, this study investigates the moderating effect of college students' nationality on their significantly different cue processing modes for low-carbon products.

**Discussion:** The findings provide new insights into better understanding the factors affecting college students' low-carbon consumption behavior in a CBEC setting and have some practical implications.

KEYWORDS

**low-carbon product, context cue, college student, cross-border purchase intention, S-O-R model**

## 1 Introduction

Environmental problems caused by $CO_2$ emissions to nature are increasing rapidly. To reduce the harm of carbon emissions, various policies are put forward around the world (e.g., South Korean "Green New Deal" and Chinese "30•60 carbon peak and neutrality strategic goals"). Following that, more and more low-carbon products appear in online and offline markets, and global scholars and managers in various fields are paying attention to

environmental issues (ElHaffar et al., 2020). Especially, in the field of cross-border e-commerce (CBEC), the emergency of low-carbon products and green consumption represents the inevitable trend (Xue et al., 2022). Thus, improving consumers' purchase intention for low-carbon products on the CBEC platform can effectively solve global environmental concerns and achieve the dual growth of economic and environmental performance (Wu et al., 2021). At the same time, prior research reveals that college students have emerged as a part of a critical consumer segment globally due to their strong consumption power, their influence in family decision-making, and their leading role in different social groups (van Berlo et al., 2020). Moreover, based on the development of online shopping and the integration of the global economy, the direct or indirect consumption of CBEC by college students is increasing year by year. Therefore, promoting college students' low-carbon consumption behavior in a CBEC setting would be a significant part in improving the global low-carbon development, which has not received sufficient attention.

Previous CBEC research has not only focused on the positive impact of cross-border transaction volume on the macro-economy but also on the improvement of the shopping experience on CBEC platform microlensing. Recently, with the increasing environmental concerns around the globe, some scholars and managers have tentatively investigated the low-carbon consumption promotion strategy in an online setting (Wu et al., 2021), while the studies on low-carbon consumption on the CBEC platform from a B2C perspective are still in its infancy. Thus, identifying the significant factors on attracting much more online consumers and influencing their low-carbon product purchase intention or behavior finally have become critical for environmental and financial performance purposes for all CBEC platforms (Abdulkarem and Hou, 2021). Based on the Stimulus-Organism-Response (S-O-R) model, previous studies have emphasized that consumers' internal emotional reactions can be influenced by various external stimuli (e.g., online shopping context cues; Zhu et al., 2020). Owing to the rich and diverse information of the CBEC platform, firms should obtain consumers' attention to create more business opportunities. It is argued that consumers' attention always closely correlates with contextual cues. Online shopping context cues are widely used in traditional import/export trade businesses as a representative and effective external stimulus. The effect of online shopping context cues can take place in the attention guidance stage, which subconsciously reinforces consumers' impressions. Therefore, cross-border online shopping context cues can be used to capture consumers' attention and thus further affect cross-border purchase intention (CBPI). Considering the high added value and negative image (e.g., high premium, poor quality, and false publicity) of low-carbon products (Wang et al., 2020) and college students' leading role in different social classes, there is a lack of empirical studies on investigating the antecedents of consumers' overall perceptions and ultimate purchase intention for low-carbon products in a CBEC setting. To address this research gap, this study attempts to explore the significant effects of online shopping context cues (e.g., price discount, carbon label, and social commentary) on enhancing college students' overall perception of low-carbon products to achieve a win–win result for all consumers, CBEC platforms, and the environment.

In the same vein, this study also attempts to examine the effect of external stimuli on the ultimate purchase intentions of college students for low-carbon products on the CBEC platform through their overall perception formation. Some previous studies have revealed the explaining role of consumers' hedonic and functional perceived value (Xiao et al., 2019) and retailer trust (Cui et al., 2019) on the formation mechanism of consumers' green consumption on the CBEC platform, while according to the valence framework, individuals' trust and perceived risk are two representative perceptions, which contribute to affect individuals' final decision-making (Mou et al., 2019a). Moreover, previous studies have not sufficiently explained the influence of online shopping context cues and college students' trust and perceived risk on their cross-border purchase intention (CBPI) for low-carbon products (Mou et al., 2019b). Therefore, this study attempts to examine how trust and perceived risk build college students' overall perceptions of college students in relation to cross-border online shopping context cues for the consumption of low-carbon product consumption according to the valence framework.

Furthermore, on account of different habits, languages, education, cultures, lifestyle, and family environment, students constantly focus on different external stimuli of products and online shopping situations (Kim et al., 2017; Li et al., 2017). Hence, college students from different countries (e.g., South Korea vs. China) will elicit different perceptions of online consumption context (Halder et al., 2020). Although both South Korea and China are representative collectivistic countries (Hofstede, 1984), they show different (low-carbon) online shopping behaviors due to their different cultural educations, economy policies, and political environment, which may lead to predictable differences in low-carbon consumption processing in a CBEC setting. In conclusion, this study aims to compare the differential impact of context cues on trust and perceived risk for low-carbon products among South Korean and Chinese college students to unveil their distinct cognitive processes in information processing on CBEC platforms.

Overall, this study makes three main contributions to college students' low-carbon consumption and CBEC research area. First, we focus on college students' low-carbon consumption on the CBEC platform and explain the influence mechanism of online shopping context cues on improving college students' trust and perceived risk for low-carbon products in a CBEC setting. Specifically, this study demonstrates how online shopping context cues for low-carbon product information can be used to reduce individuals' perceived risk and promote trust so that they can finally transfer to students' low-carbon purchase intention on the CBEC platform. Second, the valence framework, as a theoretical model, explains the significant effects of trust and perceived risk on CBPI for low-carbon products through CBEC platform. Third, based on different cultures, languages, and education, this study investigates the moderating effect of college students' nationality on their significant different cue processing modes for low-carbon products in a CBEC setting.

## 2 Theoretical background and hypotheses

### 2.1 S-O-R model in CBEC

Scholars are describing a consistent and clear research frame of the S-O-R model, which has been widely used to examine the significant effects of product properties, situational stimulus, shopping contexts on assessing product/services quality, consumers' attitude formation, and subsequent purchase decision-making (Zhu et al., 2020). Based on the S-O-R model, physical external stimulus (S) (e.g., music, smell, and

even sense of touch) and situational external stimulus (e.g., scenario design, decoration, price, and communication) may trigger individual's internal reactions such as satisfaction, pleasure, superiority, or even anger (O), which subsequently influence individual's final intention or behavior for consumption (R) (Zhu et al., 2020).

The S-O-R model has been widely used in analyzing the formation mechanism of individuals' cognition and perception of (cross-border) online shopping and explaining how the perception subsequently contributes to their final purchase decision-making (Zhu et al., 2020; Liu et al., 2021). For instance, Zhu et al. (2020) developed a conceptual model to explain consumers' impulse purchase behavior in a CBEC setting based on the S-O-R model. The findings emphasized that an effective product description (including display or content) has a positive influence on consumers' curiosity, which subsequently stimulates their impulse purchase intention in a CBCE setting. Similarly, several studies have attempted to explore the antecedents of low-carbon product purchase intention in online/offline shopping environments, based on the S-O-R theoretical approaches (Song et al., 2022).

## 2.2 Relation between context cues and individuals' trust and perceived risk

Previous research has emphasized various antecedents of consumers' overall perception and purchase intention on low-carbon (green) products (Liu et al., 2016; Abdulkarem and Hou, 2021; Rondoni and Grasso, 2021; Wang et al., 2022). For instance, focusing on the food industry, Rondoni and Grasso (2021) conducted a literature review and revealed that individuals' demographics and carbon labels' context type significantly influence consumers' overall perception and final low-carbon behavior. Abdulkarem and Hou (2021) directly investigated the effects of products' technological context, organizational context, and environmental context on consumer's CBEC adoption in China. Wang et al. (2022) provided empirical support with regard to the improvement of SNS users' trust by enhancing consistency, fit, and impact communication context cues. After sorting out the antecedents in previous research, this study attempts to combine the characteristics of online shopping and low-carbon products and examine the online shopping context cues, namely, price discount, carbon label, and social commentary, that are positioned as representative attributes that influence college students' trust and perceived for context cues in a CBEC setting in South Korea and China.

1. Price discount refers to a short-term product price reduction for all or specific consumers, which invariably can increase product sales and market share in a short-time effectively (Zhu et al., 2018). Price discount is a basic and useful marketing mix strategy in both online and offline shopping settings on improving individuals' decision-making process. Giuffrida et al. (2017) revealed that price discounts have a significant effect on consumers' online purchase decision-making and emphasized this feature by increasing economic stimulus (Tan, 2022). In practice, numerous South Korean and Chinese consumers are sensitive to price fluctuation, which can be verified by *6·18 big sales, the 11·11/12·12 promotion*, and *Christmas/new year big sale* phenomenon.

For low-carbon products, as pleasant surprises, appropriate price reduction can satisfy individuals' wants for excellent and inexpensive products, reduce the risk perception caused by elevated prices, and then trigger their final green consumption behavior. For cost and technical reasons, low-carbon products always have higher prices (vs. general products). Therefore, if the products are offered by two retailers at different prices in a CBEC setting, which can be predicted to improve individuals' overall perceived trust and reduce overall perceived risk. Hence, price discount cues are also used to improve consumers' utilitarian value and reduce their uncertainty perception (Wang et al., 2020).

2. Carbon labels refer to the marker disclose information about carbon emissions and the impact that their production has on the environment, which can help consumers make more sustainable purchase decisions (Rondoni and Grasso, 2021). By choosing the right contents and consumer match, carbon labels can be used for educating potential consumers about the characteristics of firms' production (Wong et al., 2020). Recently, the implementation of carbon labeling has become a pressing concern for all industries, including CBEC platforms, as they seek to capture consumers' attention and increase their purchase intention. In such circumstances, some managers and scholars have not only focused on the positive effect of label carbon on the macro-economy but also investigated the improving effects of carbon labels on online/offline shopping environment (Liu et al., 2016). For instance, Grunert et al. (2014) compared the effect on consumers between traditional attributes (e.g., fat content, origin, and price) and food sustainable production attributes (e.g., ecological footprint and health-related aspects). Wong et al. (2020) addressed the carbon footprint of beverage products and investigated consumers' purchase attitude and behavior toward carbon labels.

The objectivity (e.g., accurate data and authoritative certification) and the independence (e.g., certified by an authority) of carbon labels have made consumers unconsciously persuaded (Grunert et al., 2014). Individuals can receive useful carbon emission or green production information from carbon labels presented online; hence, they can easily understand the green properties of the products on the CBEC platform, which helps to improve the shopping experience and reduce risk perception effectively (Zhao et al., 2018). At the same time, novel, objective, authoritative, and intriguing low-carbon contents can awake individuals' environmental awareness and enable consumers' intention on online shopping activities to improve their emotional trust and decrease perceived risk (Lee, 2017).

3. Social commentary is a combination of contents presented by individuals with SNS, which refers to a virtual community where all users can share views, lifestyle, consumption experiences, and ideas with each other (Chen et al., 2021). With the rapid growth of social media, it has attracted more and more college students. At the same time, CBEC platforms and individual retailers have noticed that consumers' positive commentaries on social media can be a huge boost to product sales and brand improvement; thus, they tend to encourage consumers to actively discuss and share the perception of their

consumption experience by writing comments on *Facebook, Instagram, KakaoTalk, Blogs, WeChat, QQ zone BBS*, etc. (Chen et al., 2021).

Previous findings has emphasized that consumers' social commentary cues influence consumers' trust effectively in a general online shopping context, that is, the textual commentary is always regarded as a useful evaluation of consumers' perception of consumption experience, which, moreover, provides a guaranteed set of messages for potential consumers' low-carbon products consumption processing mode (Wang et al., 2023). Moreover, various social commentaries involve pre-contractual (e.g., carbon emission and product quality description) and post-contractual (e.g., delivery risk, environmental pollution risk, and financial risk) information, which can effectively eliminate individuals' risk perception in a CBEC online shopping setting (Mou et al., 2019a). Therefore, social commentary cues (e.g., user experience, product rating, and issue discussion for low-carbon products) on SNS should become essential influencing factors on individuals' overall perception and final purchase behavior. In conclusion, we propose hypotheses as follows:

> Hypotheses: Cross-border online shopping context cues (H1a: price discount cues, H2a: carbon label cues, and H3a: social commentary cues) for low-carbon products contribute positively to college students' trust.

> Hypotheses: Cross-border online shopping context cues (H1b: price discount cues, H2b: carbon label cues, and H3b: social commentary cues) for low-carbon products contribute negatively to college students' perceived risk.

## 2.3 Valence framework and college students' trust/perceived risk → CBPI relationship

The direct or indirect effects of consumers' overall perception on their purchase intention/behaviors have been widely emphasized by many studies (Mou et al., 2019b). In some studies, individuals' overall perception is considered as a multidimensional concept. For instance, Xiao et al. (2019) discuss the significant effect of consumers' perceived emotional and functional value on online purchase intention. While, based on the valence framework, individuals can format both positive and negative perceptions from a (cross-border) online shopping transactions (Cui et al., 2019), the valence framework explains individual trust and perceived risk as two crucial dimensions in influencing their final decision-making. Specifically, as an estimate of received utility from a product or context cues, individuals' overall trust always plays an essential role in their purchase decision-making process (Wang et al., 2023). Moreover, individuals' perceived risk is the negative valence system that detracted from their consumption behavior and is primarily caused by information asymmetry in the online shopping context, especially for low-carbon products on CBEC, which are closely related to misleading communication and high green premium (Mou et al., 2019a).

Previous findings emphasize that individuals tend to increase their net assessment of utility in the general process of consumption (Peter and Tarpey, 1975), that is, in a CBEC setting, college students who received context cues for low-carbon products will compare their benefits in the consumption process with their costs or effort, and the final purchase decision will be made when they get adequate net profit and trust (Ventre and Kolbe, 2020). As a significant factor driving individuals' online consumption behavior, individuals' trust is widely investigated that it provides a strong stimulus for their adoption of online/offline shopping (Ventre and Kolbe, 2020), Internet/mobile low-carbon consumption (Liu et al., 2016), and even cross-border shopping consumption process (Har Lee et al., 2011). Thus, we propose the hypothesis as follows:

> H4: College students' trust for context cues contributes positively to their CBPI for low-carbon products in a CBEC setting.

On the contrary, when buying low-carbon products on a CBEC platform, individuals face a lot of information, and their limited knowledge of low-carbon products and relative shopping experience may lead to further misunderstanding of the products or increase uncertainties about retailers' behaviors (Ding et al., 2018). At the same time, individuals cannot predict the outcome of future transactions on CBEC platforms accurately; thus, it is difficult for college students to assess the profits of CBEC transactions (Mou et al., 2019b). According to the valence theory, individuals tend to reduce disutility in the ordinary shopping process (Peter and Tarpey, 1975); thus, it is difficult for individuals to make consumption decisions in a high risky state. Moreover, some prior studies revealed that individuals' perceived risk has a negative effect on their purchase intentions and behavior for low-carbon products in e-commerce shopping settings (Chiu et al., 2012; Ventre and Kolbe, 2020). Thus, we propose hypothesis as follows:

> H5: College students' perceived risk for contest cues contributes negatively to their CBPI for low-carbon products in a CBEC setting.

## 2.4 Comparison of south Korean and Chinese college students

Numerous individuals' characteristics have been investigated in the context of diverse online green shopping process literature (Kim et al., 2017; Jiang et al., 2020). Different individual's complex information processing for low-carbon product purchasing is always discussed in the sustainable management literature (Halder et al., 2020; Xue et al., 2022). With the proposal of South Korean "*Green New Deal*" and Chinese "*30•60 carbon peak and neutrality strategic goals*," the environmental awareness of residents in both countries has been considerably improved (Ding et al., 2018), especially college students who received advanced education. Although both South Korea and China are representative collectivistic countries (Hofstede, 1984), they show different (low-carbon) online shopping behaviors due to their different cultural educations, economy policies, and political environment, which may lead to predictable differences in low-carbon consumption processing in a CBEC setting.

Specifically, this study aims to predict this difference from the cultural discrepancy and green value perspectives. First, individuals' collectivism has been investigated to have a positive effect on their pro-environmental consumption behavior (Lee, 2017; Halder et al.,

2020). Although there are some cultural similarities between South Korea and China, which are influenced by Confucianism, South Korean residents show a stronger collectivism in many aspects (Lee, 2017). Therefore, South Korean college students will show extra enthusiasm in low-carbon product information processing. Second, South Korea has adopted the concept of sustainable development as a guiding principle in its environmental policy, law, and education. Compared with China, low-carbon consumption has a better mass base in South Korea (Lee, 2017). Therefore, various information about low-carbon products is more acceptable to the youth people in South Korea and is influenced by them. In conclusion, we suggest that, for South Korean (vs. Chinese) college students' low-carbon products in a CBEC setting, external cues may lead to stronger stimulating and influential effects. We propose the following hypothesis:

> H6: There will be different influence of the context cues on South Korean vs. Chinese college students' trust and perceived risk in low-carbon product shopping process through CBEC, that is, there will be a stronger influence of the context cues on South Korean (vs. Chinese) college students' trust and perceived risk in low-carbon product shopping process through CBEC.

In sum, to examine the hypotheses about "context cues (including price discount, carbon label, and social commentary) → college students' trust and perceived risk → CBPI for low-carbon products" relationship between South Korea and China, we develop a structural model shown in Figure 1.

# 3 Methods

## 3.1 Measurement development

Based on the hypotheses of the proposed conceptual model, and combining with the object and specific conditions of this research, the measurements used in this study were adapted from previous empirical research (see Appendix). (1) Three context cues: we measured three kinds of context cues by asking students to answer nine questions, three items in each part, adapted from Xiao et al. (2019) and Wong et al. (2020). (2) Students' trust and perceived risk: this study measured students' trust with a three-item scale adapted from Ventre and Kolbe (2020) as well as evaluated the perceived risk with a three-item scale adapted from Bianchi and Andrews (2012) and Ventre and Kolbe (2020). (3) Cross-border purchase intention for low-carbon products: based on Chiu et al. (2012), we adapted three items to measure CBPI. Finally, participants' age, education, gender, and monthly expenditure on online shopping were asked as control variables.

## 3.2 Survey design and sample

The survey instrument was piloted using a number of South Korean and Chinese college students who have experience in cross-border online shopping to assess its appropriateness. In addition, two academics from reputable universities and two online shopping experts examined the questionnaire to assess the face and content validity.

The survey was collated in English and was translated into official South Korean and Chinese languages by two South Korean and two Chinese independent researchers (Hair et al., 2011). After completing the translation, another two professors then back translated the South Korean and Chinese surveys to avoid differences between the two surveys and the English version. This study adopted a between-subject (South Korean college student vs. Chinese college student) design. We collected survey data from South Korean and Chinese college students who have more than one experience in cross-border online shopping (the first question in the questionnaire). To maximize the valid questionnaire collection, both offline and online surveys were distributed. The process had lasted for nearly 7 weeks. All participants were given the survey and asked to recall their recent online shopping experience in a CBEC setting. A total of 817 surveys were distributed, of which a total of 429 were returned (the response rate of 52.6%). After eliminating the questionnaires that did not meet the criteria and

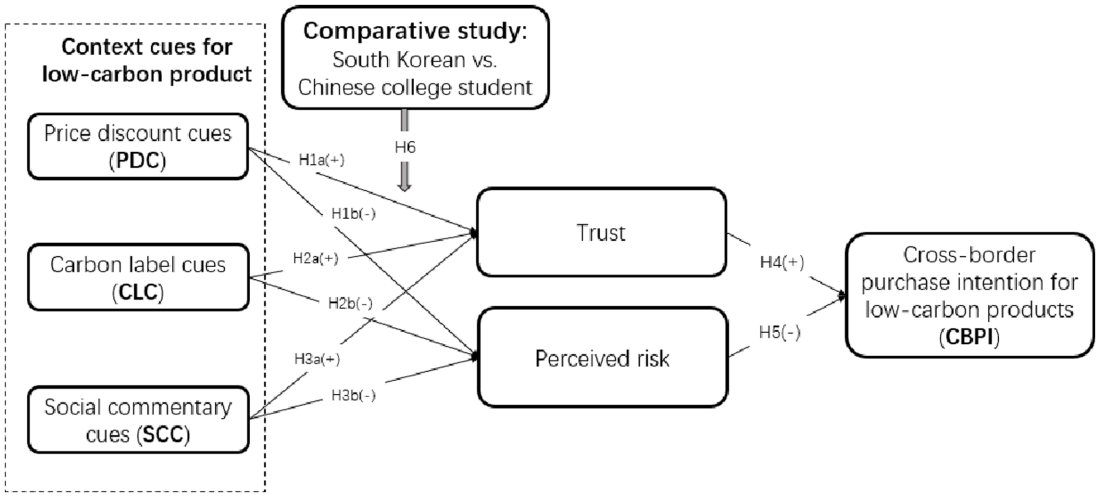


FIGURE 1
Structural model.

were incomplete, a final sample of 352 usable data was used in the final empirical analysis. The degrees mentioned in most samples are junior college (58.2%) followed in second by an undergraduate course, as reported by more than 38.4% of the study sample participants. Detailed descriptive statistics for all students are shown in Table 1.

TABLE 1 Descriptive statistics of all respondent characteristics.

| Demographics | Category | Count | Rate (%) |
|---|---|---|---|
| Nationality | South Korea | 170 | 48.3 |
| | China | 182 | 51.7 |
| Gender | Women | 172 | 48.9 |
| | Men | 180 | 51.1 |
| Age (years) | 17–18 | 52 | 14.8 |
| | 19–20 | 140 | 39.7 |
| | 21–22 | 148 | 42.1 |
| | 23 or above | 12 | 3.4 |
| Education | Junior college | 205 | 58.2 |
| | Undergraduate | 135 | 38.4 |
| | Graduate course | 12 | 3.4 |
| Monthly expenditure on online shopping ($) | ≤ 50 | 31 | 8.8 |
| | 51–100 | 94 | 26.7 |
| | 101–150 | 121 | 34.4 |
| | 151–200 | 81 | 23.0 |
| | ≥ 200 | 25 | 7.1 |
| Total | | 352 | 100 |

# 4 Results

## 4.1 Non-response and common method bias

First, this study divided the independent variables and dependent variables into different parts of the survey to minimize the potential effects of common method variance (Podsakoff et al., 2003). Second, to verify the possible common method bias, based on exploratory factor analysis, we conducted Harman's single-factor test (Podsakoff et al., 2003). Exploratory factor analysis yielded six factors with eigenvalues above 1.0, which explained 88.8% of the total variance. Thus, there was no serious common method bias in this study. Third, to avoid the non-response bias, we divided all samples randomly into two different groups and tested the differences between their characteristics and demographic data (Armstrong and Overton, 1977). There was no significant difference between the two groups, meaning that non-response bias is not a major issue.

## 4.2 Validity and reliability of measurement model

Using the full sample ($N = 352$) data, we conducted a confirmatory factor analysis with AMOS 18 on six constructs, 18 items. First, to calculate the convergent validity, we linked each item to its corresponding construct and estimated the covariance among all constructs. The fit of model resulted in $\chi^2 = 173.953$ ($df = 120$, $p < 0.05$); $RMSEA = 0.036$; $RMR = 0.042$; $GFI = 0.950$; $CFI = 0.981$; and $NFI = 0.972$, the overall fitness of this CFA model was good, and all of the factor loading scores were above 0.60 and $t$-values were higher than 1.96 (see Table 2). Second, six average variance extracted (AVE) were calculated, which are all greater than the 0.60 standard, indicating significant convergent validity. Meanwhile, the correlation between all constructs was all smaller than each construct's square root of the AVE, revealing the compliance with discriminant validity (Fornell and Larcker, 1981; Hair et al., 2011; see Table 3).

TABLE 2 CFA analysis result ($N = 352$).

| Factor | Scale | S. Estimate | $t$ | AVE | C.R. |
|---|---|---|---|---|---|
| Price discount cues | PDC1 | 0.949 | - | 0.896 | 0.962 |
| | PDC2 | 0.937 | 35.793 | | |
| | PDC3 | 0.954 | 38.478 | | |
| Carbon label cues | CLC1 | 0.925 | - | 0.842 | 0.941 |
| | CLC 2 | 0.907 | 27.938 | | |
| | CLC 3 | 0.920 | 28.937 | | |
| Social commentary cues | SCC1 | 0.934 | - | 0.881 | 0.951 |
| | SCC2 | 0.932 | 32.757 | | |
| | SCC3 | 0.949 | 34.645 | | |
| Trust | Trust1 | 0.927 | - | 0.827 | 0.935 |
| | Trust2 | 0.894 | 26.918 | | |
| | Trust3 | 0.907 | 27.814 | | |
| Perceived risk | PR1 | 0.888 | - | 0.797 | 0.921 |
| | PR2 | 0.923 | 24.874 | | |
| | PR3 | 0.867 | 22.509 | | |
| Cross-border purchase intention for low-carbon products | CBPI1 | 0.853 | - | 0.733 | 0.892 |
| | CBPI2 | 0.853 | 19.029 | | |
| | CBPI3 | 0.863 | 19.273 | | |

Model fit summary: $\chi^2(120) = 173.953$; $\chi^2/df = 1.450$; RMSEA = 0.036; RMR = 0.042; GFI = 0.950; CFI = 0.991; and NFI = 0.972.

## 4.3 Structural model

This study estimated the full sample ($N = 352$) data by the AMOS program to test the structural effect of all six constructs (including three context cues, students' trust/perceived risk, and CBPI), resulting in an acceptable level of multicollinearity. According to Table 4, model fit showed that $\chi^2 = 182.353$ ($df = 124$, $p < 0.001$); $RMSEA = 0.037$; $RMR = 0.054$; $GFI = 0.948$; $CFI = 0.990$; and $NFI = 0.971$, and the overall model fitness was good. Three context cues contributed positively to trust (PDC: $\beta = 0.400$, $t = 8.435$; CLC: $\beta = 0.234$; $t = 5.044$; SCC: $\beta = 0.293$, $t = 6.224$), and H1a–H3a were all supported. Furthermore, three context cues contributed negatively to perceived risk (PDC: $-0.144$; $t = -2.612$; CLC: $\beta = -0.265$, $t = -4.797$; SCC: $\beta = -0.265$; $t = -4.763$), and the resulting H1b–H3b were all supported. As speculated, H4 and H5 were also supported in that trust contributed

TABLE 3 Discriminant analysis result ($N = 352$).

| | PDC | CLC | SCC | Trust | Perceived risk | CBPI |
|---|---|---|---|---|---|---|
| PDC | 0.946 | | | | | |
| CLC | 0.294** | 0.917 | | | | |
| SCC | 0.334** | 0.283** | 0.938 | | | |
| Trust | 0.546** | 0.419** | 0.475** | 0.909 | | |
| Perceived risk | −0.297** | −0.365** | −0.375** | −0.396*** | 0.893 | |
| CBPI | 0.259** | 0.205** | 0.315** | −0.416** | 0.435** | 0.856 |

Diagonal value is the square root of AVE value; table value is correlation coefficient; $^{**}p < 0.01$; $^{***}p < 0.001$.

positively and perceived risk contributed negatively to CBPI for low-carbon products (Trust: $\beta = 0.356$; $t = 6.412$; Perceived risk: $\beta = -0.310$; $t = -5.539$; see Table 4; Figure 2). In addition, we tested all control variables and found no significant influence.

## 4.4 Moderating effect of nationality

Following the structural analysis, H6 explained the different effects of context cues → trust and context cues → perceived risk relationships of South Korean and Chinese college students' low-carbon consumption process on CBEC, and multi-group comparison analysis by AMOS was performed. Theoretically, there are different rules for a minimum sample size for SEM, for example, a minimum sample size of 100 or 200, 5 or 10 observations per estimated parameter, and 10 cases per variable (Wolf et al., 2013). The larger sample size can obtain better estimates of parameters and chi-squared probabilities. However, previous research indicates that the marginal sample sizes can also be associated with a satisfactory fit, low Type-I error rates, and stable model parameters (Sideridis et al., 2014). Although the sample size for this study is not idealistic, it meets the rules of the minimum sample size for SEM. Therefore, the structural analysis for two separate groups is feasible (Li and Jacobucci, 2022; Alrawad et al., 2023).

First, we divided two separate groups: South Korean college student group vs. Chinese college student group. The results in Table 5 show that, in the South Korean student group, all three context cues contributed positively to trust (PDC: $\beta = 0.371$, $t = 5.496$; CLC: $\beta = 0.246$, $t = 3.694$; SCC: $\beta = 0.335$, $t = 4.898$). Moreover, all three context cues contributed negatively to perceived risk (PDC: $\beta = -0.430$, $t = -6.183$; CLC: $\beta = -0.315$, $t = -4.608$; SCC: $\beta = -0.182$, $t = -2.651$). Similarly, in the Chinese consumer group, all three context cues contributed positively to trust (PDC: $\beta = 0.273$, $t = 3.621$; CLC: $\beta = 0.211$, $t = 2.867$; SCC: $\beta = 0.275$, $t = 3.760$), and all three context cues contributed negatively to perceived risk (PDC: $\beta = -0.198$, $t = -2.546$; CLC: $\beta = -0.167$, $t = -2.189$; SCC: $\beta = -0.328$, $t = -4.223$). In conclusion, except "SCC → Perceived risk" path (which is contrary to prediction), the $\beta$ value of each path in the South Korean student group was all greater than those in the Chinese student group (see Figure 3).

Finally, to test the moderating effect of college students' nationalities on context cues → trust/perceived risk relationship, $\triangle\chi^2$ ($df = 1$) value between the constraint model and the free model in each path is shown. The results revealed that three differences were significant at $a = 0.05$ level (PDC → Trust: $\triangle\chi^2 = 4.3 > 3.84$; CLC → Trust: $\triangle\chi^2 = 6.2 > 3.84$; SCC → Perceived risk: $\triangle\chi^2 = 4.6 > 3.84$), while no significant differences were found in "SCC → Trust: $\triangle\chi^2 = 0.1 < 3.84$; PDC → Perceived risk: $\triangle\chi^2 = 1.1 < 3.84$; CLC → Perceived risk: $\triangle\chi^2 = 2.3 < 3.84$ paths. Thus, H6 was partially supported (see Table 6).

TABLE 4 Structural analysis results ($N = 352$).

| Pathway | | S. Estimate | S. E. | $t$ | Results |
|---|---|---|---|---|---|
| H1a | PDC → Trust | 0.400 | 0.038 | 8.435*** | Accepted |
| H2a | CLC → Trust | 0.235 | 0.042 | 5.044*** | Accepted |
| H3a | SCC → Trust | 0.293 | 0.038 | 6.224*** | Accepted |
| H1b | PDC → Perceived risk | −0.144 | 0.038 | −2.612** | Accepted |
| H2b | CLC → Perceived risk | −0.265 | 0.044 | −4.797*** | Accepted |
| H3b | SCC → Perceived risk | −0.265 | 0.038 | −4.765*** | Accepted |
| H4 | Trust → CBPI | 0.356 | 0.053 | 6.412*** | Accepted |
| H5 | Perceived risk → CBPI | −0.310 | 0.062 | −5.539*** | Accepted |

Model fit summary: $\chi^2(124) = 182.353$; $\chi^2/df = 1.471$; GFI = 0.948; CFI = 0.990; NFI = 0.971; RMSEA = 0.037; RMR = 0.054; $^{**}p < 0.01$.$^{***}p < 0.001$.

# 5 Conclusion and discussion

This study examines the "three context cues for low-carbon products → college students' overall perception → CBPI for low-carbon products" relationship, as we as the moderating effect of college students' nationality on the relationship between three types of contextual cues and trust/perceived risk. First, the findings revealed that all three context cues (price discount, carbon label, and social commentary) have significant positive effects on trust and negative effects on perceived risk. Moreover, trust positively and perceived risk negatively impact college students' CBPI for low-carbon products, supporting H1–H5. These results are relevant, as a basic and useful marketing mix strategy, and the significant effects of price discount/information disclose (carbon label)/SNS communication (social commentary) on improving individuals' decision-making process are widely investigated (Giuffrida et al., 2017; Wang et al., 2020; Chen et al., 2021; Tan, 2022). Specifically, some previous studies suggest that the price of a product will lead to consumers' doubts about the quality of the product (Keller et al., 2022; Tan, 2022). However, in this study, consumers show a positive attitude on price discount, that is, the

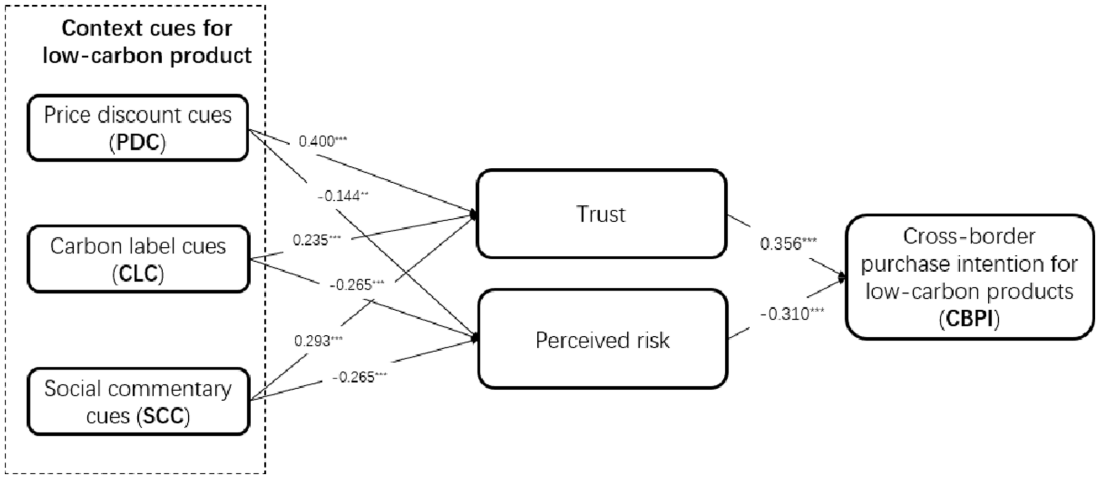


FIGURE 2
Results of structural analysis (**$p < 0.05$; ***$p < 0.001$).

TABLE 5 Structural analysis for two separate groups.

| Pathway | South Korean college student (Group A, $n1 = 170$) | | Chinese college student (Group B, $n2 = 182$) | |
|---|---|---|---|---|
| | St. Path coefficient | $t$ | St. Path coefficient | $t$ |
| PDC → Trust | 0.371 | 5.496*** | 0.273 | 3.621*** |
| CLC → Trust | 0.246 | 3.694*** | 0.211 | 2.867** |
| SCC → Trust | 0.335 | 4.898** | 0.275 | 3.760*** |
| PDC → Perceived risk | −0.430 | −6.183*** | −0.198 | −2.546* |
| CLC → Perceived risk | −0.315 | −4.608*** | −0.167 | −2.189* |
| SCC → Perceived risk | −0.182 | −2.651** | −0.328 | −4.223*** |

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

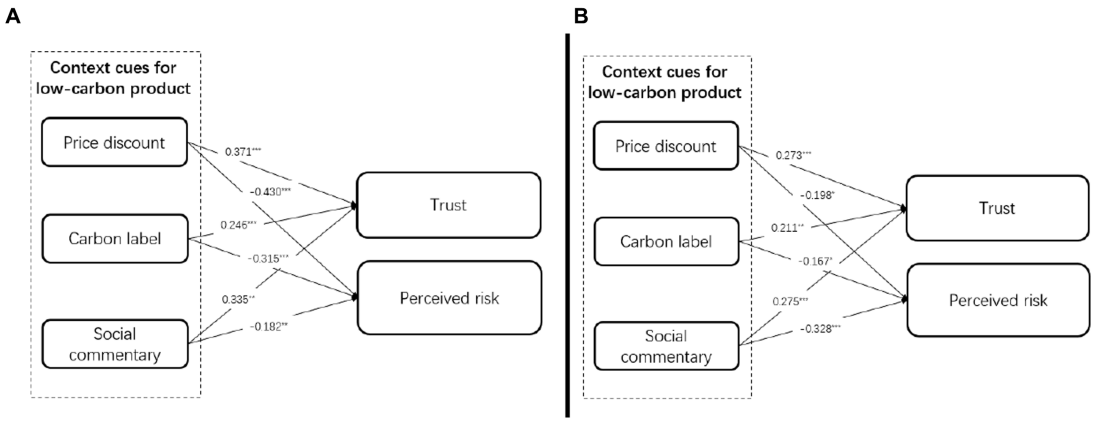


FIGURE 3
Results of structural analysis for different student groups. **(A)** South Korean college student group. **(B)** Chinese college student group.

consumers believe that lower prices represent stronger firm competence, greater production scale, and higher technology in a CBEC online shopping setting. In the same vein, appropriate carbon labels can be also used for educating potential consumers about the characteristics of firms' production (Wong et al., 2020). Compared to the traditional product consumption environment (Grunert et al., 2014; Wong et al., 2020), online low-carbon consumption contains more uncertain factors (Zhao et al., 2018). Therefore, according to our findings, the objectivity and independence of carbon labels can help consumers improve the shopping experience and reduce risk

TABLE 6 Moderating role of college students' nationality.

| Pathway | | $\chi^2$ | | $\triangle\chi^2$ ($df = 1$) | $p$ value | Results |
|---|---|---|---|---|---|---|
| | | Free model | Constraint model | | | |
| H6a | PDC → Trust | 330.3 ($df = 248$, $p < 0.001$) | 334.6 | 4.3 | <0.05 | Accepted |
| H6b | CLC → Trust | | 336.5 | 6.2 | <0.05 | Accepted |
| H6c | SCC → Trust | | 330.4 | 0.1 | n.s. | Rejected |
| H6d | PDC → Perceived risk | | 331.4 | 1.1 | n.s. | Rejected |
| H6e | CLC → Perceived risk | | 332.6 | 2.3 | n.s. | Rejected |
| H6f | SCC → Perceived risk | | 334.9 | 4.6 | <0.05 | Rejected |

Standard $\triangle\chi^2_{(df=1)} = 3.84$.

perception effectively. At the same time, social commentaries including pre-contractual and post-contractual information can effectively eliminate individuals' risk perception in a CBEC online shopping setting (Mou et al., 2019a).

Furthermore, as our experimental findings reveal that, in the South Korean (vs. Chinese) college student group, all three context cues for low-carbon products have a significant stronger impact on trust; moreover, price discount and carbon label cues have stronger effects on perceived risk as assumed. Thus, H6 is partially supported. Some previous studies have investigated various psychological and behavioral differences between South Korea and China in general online/offline consumption process (Chu et al., 2019; Fan et al., 2022; Wang et al., 2022). Nationality and cultural differences are rarely addressed in investigating consumers' low-carbon consumption behavior (Wang et al., 2023). While, as we investigate in this study, due to different cultural educations, economy policies, and political environment, South Korean and Chinese college students have shown predictable differences in low-carbon consumption processing in a CBEC setting; therefore, it is particularly important to study the differences in low-carbon consumption characteristics through the lens of regional and cultural differences (Shavitt and Barnes, 2020; Fan et al., 2022).

# 6 Implications and limitations

## 6.1 Theoretical contributions

First of all, this study augments advances in the S-O-R model with insights from low-carbon consumption and CBEC literature to theorize how college students process contextual cues for low-carbon products in a CBEC setting. In terms of the positive impact of online shopping context cues on trust by price discount cues rank first, that by social commentary cues second, and that by carbon label cues rank last. Moreover, antecedents' negative impact on perceived risk is listed as carbon label, social commentary, and price discount cues in order.

Second, the results reveal that trust positively and perceived risk negatively impact college students' CBPI for low-carbon consumption in a CBEC setting, which is not sufficiently valued by existing CBEC or green consumption literature. This study contributes to existing studies by extending the valence framework and examining the significant effect of positive (trust) and negative (perceived risk) perception on college students' CBPI for the increasing low-carbon products. This study also responds to the calls for more research on reducing consumers' attitude–behavior gap during low-carbon consumption in an online shopping context (ElHaffar et al., 2020).

Third, few studies have focused on potential differences in low-carbon consumption behavior between South Korean and Chinese college students (Lee, 2017). The findings reveal that the nationality of college students partially moderates the "context cues → trust" and "context cues → perceived risk" relationships. As a branch of green consumption research, the main contribution of this study is that it extends cultural discrepancy and green value perspectives with a better prediction power for comparing the differences between South Korean and Chinese college students' low-carbon behavior in a CBEC setting. In addition, contrast to our hypothesis, the influence of social commentary cues on perceived risk is greater in Chinese (vs. South Korean) student groups. A possible explanation for the results contrary to H6 may be that, with the development of digital technology and lifestyle changes due to COVID-19, Chinese college students pay more attention to online life and online social interaction. Therefore, Chinese (vs. South Korean) college students are more likely to be influenced by social commentary cues, which leads to positive perception and final purchase behavior.

## 6.2 Managerial implications

This study extends the study of low-carbon consumption in a CBEC setting by investigating three representative context cues as a driver of college students' CBPI for low-carbon products associating with trust and perceived risk. The findings provide several constructive managerial implications for CBEC platforms and our society. Furthermore, this study also attempts to discuss the effective measurements and managerial implications to guide college students' low-carbon product consumption behavior from the cross-border consumption behavior perception and to arouse people's awareness of low-carbon development around the globe. Growing cross-board trade volume, increasingly stringent CBEC environment, and ever-increasing environmental aware consumers have brought CBEC firms' attention to external context cues and environmental issues (Wu et al., 2021). To enhance college students' overall perception of the information and quality of various low-carbon products, as well as to strengthen their online low-carbon consumption patterns, CBEC platforms and individual sellers should develop a sophisticated marketing mix that aligns with the effective online shopping environment.

Specifically, according to the analysis results of "context cues → college students' trust and perceived risk → CBPI for low-carbon

products" relationship, CBEC platforms and individual sellers have a chance to use the appropriate information with regard to price discount, carbon label, and social commentary cues, which can enhance trust and reduce perceived risk, when promoting low-carbon products in a CBEC setting for college students. First, analysis results reveal that college students pay main attention to products' economic cost, and price discount plays the most crucial role in their online low-carbon consumption behavior. Thus, for low-carbon products that meet the standards, the platform giving appropriate subsidies (e.g., discounts, point redemption, and group building) preference should be very feasible. Second, social commentary, as an effective measure for increasing college students' trust and reducing perceived risk in online shopping, should be encouraged by CBEC platforms. With the rapid development of various kinds of social media (e.g., W*eChat*, *KakaoTalk*, *and TikTok*), CBEC platforms should invite college students to actively discuss and share the perception and evaluation of their low-carbon consumption experience, which can be provided as a set of useful messages for potential consumers' low-carbon information processing. Third, carbon label is one of the most widely used communication methods in low-carbon product online shopping context cues (Rondoni and Grasso, 2021), whereas, due to rampant contents (e.g., greenwashing and false propaganda), carbon label cues show relatively weak impact on college students' low-carbon consumption (Wong et al., 2020). Thus, in the era of digital marketing, the innovation of carbon label strategy is also an essential issue that every CBEC platform must face.

In addition, the comparative study on South Korean and Chinese college students' analysis results indicates that CBEC managers in China require distinct marketing approaches from those of South Korea. As a result, communication strategy for Chinese young people requires additional collective approaches. For instance, highlighting students' low-carbon dealing with their social members should be effective. Moreover, for South Korean college students, it requires more utilitarian approaches. For instance, real and effective price discount coupons and low-carbon communication content will be useful and effective. Simultaneously, it necessitates collaborative efforts from CBEC platforms, governments, and society to standardize online trading practices, ensure information authenticity, enhance the low-carbon education of young individuals, and foster enthusiasm for low-carbon consumption among all residents.

## 6.3 Limitations

This research also has limitations that provide advice for the future study. First, although this study used valid and reliable measurements adapted from prior studies, and advice from 45 pre-tested participants, in terms of a large population base, several important independent variables need to be explored and larger-scale exploratory research needs to be conducted in future. Second, various factors such as incentive programs might also have an impact on CBPI. Further studies are necessary to control other factors on the overall perception of college students to explore the impact of online shopping context cues on CBPI. Third, in this study, the questionnaires were mainly randomly distributed in Shandong Province (the third largest economic region in China) and Gyeonggi Province (the first largest economic region in South Korea). In view of the significant differences in economic, educational, and population levels among the regions in China and South Korea, moreover to generalize the results, participants from more provinces should be recruited.

# Data availability statement

The datasets presented in this article are not readily available because it is stated to the respondents that the data will only be used for academic research and will not be made publicly available. Requests to access the datasets should be directed to victorwang1921@163.com.

# Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants or patients/participants legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

# Author contributions

CW: Writing – original draft. XZ: Writing – original draft. RZ: Writing – original draft. YL: Writing – review & editing.

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# Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# Appendix

| Scale items in survey (seven-point Likert) | | | | |
|---|---|---|---|---|
| Variable | | Source | Items | Cronbach's α |
| Content cues | Price discount cues | Nagadeepa et al. (2015); Xiao et al. (2019) | (**PDC1**) There are many forms of price discount for low-carbon products on CBEC platforms.<br>(**PDC2**) The price discount of low-carbon products on CBEC platforms is strong.<br>(**PDC3**) Imported low-carbon products' price discount on a cross-border e-commerce platform is frequent. | 0.963 |
| | Carbon label cues | Wong et al. (2020); Xiao et al. (2019) | (**CLC1**) There are many forms of carbon label for low-carbon products on CBEC platforms.<br>(**CLC2**) The carbon label can help me to select the right low-carbon products.<br>(**CLC3**) Products' carbon label contents on CBEC platform are useful to me. | 0.941 |
| | Social commentary cues | Animesh et al. (2011); Zhang et al. (2014) | (**SCC1**) I get a good impression of other residents in the virtual world.<br>(**SCC2**) I develop good social relationships with other community members.<br>(**SCC3**) I am willing to share my own shopping experiences with my friends. | 0.956 |
| Trust | | Ventre and Kolbe (2020) | (**Trust1**) I feel safe in purchasing low-carbon products on the CBEC platform that protects my privacy.<br>(**Trust2**) I am confident in buying low-carbon products from secured CBEC platform.<br>(**Trust3**) Overall, shopping on the CBEC platform delivers me good value and trust. | 0.934 |
| Perceived risk | | Bianchi and Andrews (2012); Ventre and Kolbe (2020) | (**PR1**) I feel that purchasing low-carbon products from the CBEC platform involves a high degree of risk.<br>(**PR2**) I feel the risk associated with purchasing low-carbon products from CBEC platform is high.<br>(**PR3**) I am exposed to many transaction risks if I purchase low-carbon products online from the CBEC platform. | 0.921 |
| Cross-border purchase intention for low-carbon products | | Chiu et al. (2012) | (**CBPI1**) I will consider purchasing imported low-carbon products on the CBEC platform.<br>(**CBPI2**) I am willing to buy imported low-carbon products on the CBEC platform.<br>(**CBPI3**) I will buy imported low-carbon products through the CBEC platform within 6 months. | 0.892 |

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# Influence of environmental awareness on the willingness to pay for green products: an analysis under the application of the theory of planned behavior in the Peruvian market

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**Introduction:** This paper aimed to build a predictive model through an empirical study to examine the influence of environmental awareness (EA) on attitude (ATT) and perceived behavioral control (PBC), as well as to determine the influence of the three variables of the theory of planned behavior (TPB) on willingness to pay (WP) for green products in the Peruvian market.

**Methods:** A total of 405 Peruvian consumers were surveyed. Most of them were between the ages of 18 and 30 and single. To test the hypotheses, partial least squares (PLS-SEM) were used using the SamrtPls4 software. The results show the significant positive effect of EA on ATT and PBC. The positive and significant effect of ATT, SN, and PBC on WP was also tested A total of 405 Peruvian consumers were surveyed. Most of them were between 18 and 30 years old and single. To test the hypotheses, partial least squares (PLS-SEM) was used using SamrtPls4 software.

**Results:** The results show the positive and significant effect of AD on ATT and PBC. The positive and significant effect of ATT, SN and PBC on WP was also tested.

**Discussion:** The research provides antecedents that allow evaluation of the possibility that companies and governments adjust the dissemination strategies and related public policies regarding the impact of environmentally responsible behavior in order to contribute to the development of environmental awareness as a variable that promotes the disposition of consumers to pay for environmentally friendly products.

KEYWORDS

**willingness to pay, green products, eco-friendly products, theory of planned behavior, environmental awareness**

# 1 Introduction

The growing relevance of environmental concerns in modern society has had a noticeable effect on consumer behavior (Horani and Dong, 2023). Latin American countries have seen an increasing preference towards sustainable consumption and higher awareness of the environment (Severo et al., 2021; Valenzuela-Fernández et al., 2022; García-Salirrosas et al., 2023; Gómez-Bayona et al., 2023; Valenzuela-Fernández et al., 2023). Therefore, it is essential to understand how environmental awareness influences purchasing decisions (Hlaváček et al., 2023). Consumer behavior can considerably affect the demand for sustainable products, which contributes to reducing the environmental impact associated with production and consumption (Bósquez et al., 2022). In this scenario, it is crucial to consider that consumer behavior influences the demand for sustainable products, which helps reduce the environmental impact of production and consumption. As a result, companies and policymakers must understand how this awareness of sustainability affects consumer purchasing behavior (Xu et al., 2020; Ali et al., 2021; González-Viralta et al., 2023).

Some countries, including Peru, have regulations that promote sustainability and environmental responsibility (Adaui and Cristian, 2020). In this scenario, companies that adopt sustainable practices can gain competitive advantages by meeting the demand of increasingly environmentally conscious consumers (Kumar et al., 2021; Severo et al., 2021). This knowledge can help them to offer products that align with the values and preferences of their target customers and ultimately enhance their profitability (García-Salirrosas and Rondon-Eusebio, 2022; Gómez-Bayona et al., 2023). In this way, environmental awareness is crucial in shaping consumer preferences toward sustainable products. Awareness refers to understanding the connections between our daily actions and the environment (Xu et al., 2019). This research aims to investigate the impact of environmental awareness on consumers' willingness to pay for green products in a culturally rich and biodiverse country. Studying this topic in the Peruvian context is especially relevant since each country may have particularities regarding environmental awareness, consumer culture, and socioeconomic factors that affect purchasing decisions.

Since the beginning of the COVID-19 pandemic in October 2019, some environmental concerns have been generated for society (Ekawati et al., 2023). One of those that stands out is the awareness of consumption aspects of organic and green products that benefit health and the environment (Hoejmose and Adrien-Kirby, 2012; Popescu, 2020; Bou and Sánchez, 2023). In the same way, it has arisen with the use and preference of green products or services that positively impact the environment (Ekawati et al., 2023). This change in the paradigm has motivated the planning and execution of strategies during and after the COVID-19 pandemic from economic, social, environmental, and cultural points of view (Da'ar and Kalmey, 2023). There is increasing evidence of a growing preference for sustainable consumption and greater environmental awareness in Latin American countries (Severo et al., 2021; Valenzuela-Fernández et al., 2023). Therefore, studying this topic in the Peruvian context is particularly relevant, as each country may have unique characteristics regarding environmental awareness, consumer culture, and socioeconomic factors that influence purchasing decisions.

The intention of the younger generations to purchase green and healthful products has become more apparent. Decades ago, there was no concern regarding this issue; however, care for the environment is being pursued related to the limitation and quantity of natural resources (Pérez and Hernández, 2020; Alvarez-Risco et al., 2021; Kumar et al., 2021; Valenzuela-Fernández et al., 2022; Bósquez et al., 2023). In this context, consumer purchasing behavior is influenced by economic, political, ahoyosdnd cultural factors and environmental factors (Bertram and Chi, 2017). However, society has yet to reach a consensus on the most important factor, as some consumers may prefer products with more ecological manufacturing processes (Müller-Pérez et al., 2022). In contrast, others may choose the final product without regard to the manufacturing process (Fuentes, 2015). Therefore, society and organizations struggle to identify the factors that influence the selection of an eco-friendly product. Society and organizations are currently focused on identifying the factors that impact the selection of eco-friendly products (Lee, 2011; Kumar and Ghodeswar, 2015). This research aims to answer the question of whether environmental awareness affects the willingness of consumers to pay for green products in the Peruvian market.

The present study applies Ajzen's (2002) theory of planned behavior to understand the phenomenon of sustainable product choice better. This conceptual framework examines attitudes, subjective norms, and how people think they can control their behavior. It gives us a solid foundation for why people choose sustainable products. This study applies the theory of planned behavior as a conceptual framework because we need to do more than describe the relationship between environmental awareness and willingness to pay. We need to understand what drives people to act in these ways. This theoretical approach is widely recognized in consumer psychology, providing a solid framework for unraveling the complexities of attitudes, subjective norms, and perceptions of control that influence sustainable purchasing decisions (Xu et al., 2020; Valenzuela-Fernández et al., 2023). Therefore, the main focus of this study is to investigate how environmental awareness (EA) influences attitude (ATT) and perceived behavioral control (PBC), and how the three variables of the theory of planned behavior (TPB) impact the willingness to pay (WP) for green products in the Peruvian market.

The article's structure follows: The introductory section overviews the research context. The second section conducts a thorough literature review, examining theories, studies, and prior approaches relevant to our research topic. The third section outlines the methodology employed, detailing the techniques and procedures for data collection. The fourth section then presents the outcomes of the thorough analysis with supporting empirical evidence. The fifth section discusses these results, contextualizing the findings of the reviewed literature. Finally, the sixth section concludes the article by summarizing key findings, addressing limitations, and suggesting potential avenues for future research. This structured approach aims to provide a comprehensive and coherent understanding of the conducted research.

# 2 Literature review

## 2.1 Research variables

### 2.1.1 Willingness to pay for green products

Willingness to pay is conventionally conceptualized as the highest price a consumer desires for a product or service (Wertenbroch and Skiera, 2002; Ioana-Daniela et al., 2018; Schmidt and Bijmolt, 2020). Studying consumers' Willingness to Pay is critical for a better

understanding of business and academic areas of their impact on learning purchase intention (Schmidt and Bijmolt, 2020; Becerril-Castrillejo and Muñoz-Gallego, 2022a; Becerril-Castrillejo and Muñoz-Gallego, 2022b). Willingness to pay is based on the individual's value factor, particularly regarding sustainable products and industries. Therefore, costs or prices are drivers of motivation to pay (Yadav and Pathak, 2017; Walcher and Ihl, 2020).

Recent studies have affirmed that environmental awareness and sustainable consumption have increased among the population during the COVID-19 pandemic (Ali et al., 2021; Severo et al., 2021; Valenzuela-Fernández et al., 2022; Valenzuela-Fernández and Escobar-Farfán, 2022; García-Salirrosas et al., 2023; Gómez-Bayona et al., 2023; Valenzuela-Fernández et al., 2023). Therefore, it could suggest that consumer willingness to pay for ecological products has been strengthened or increased. COVID-19 has modified individuals' purchasing of healthier and quality products (Wang et al., 2020). Also, quarantines and confinements have increased the desire to pay for green spaces to help the environment (Manso et al., 2021). For instance, González-Viralta et al. (2023) have affirmed that adopting environmentally friendly practices in supermarkets within the context of Chilean economics has a direct and favorable impact on customer willingness to pay for green products. Also, Prakash et al. (2019) and Kumar et al. (2021) highlighted that young environmentally conscious consumers are quickly paying a high price for green packaging. People generally intend to pay for a product or service to be more environmentally friendly (Doli et al., 2021). In this context, green consumption has become increasingly significant within the business sector and the academic community (Bósquez et al., 2023). Hence, a positive relationship was found between behavioral intention and willingness to pay.

### 2.1.2 Environmental awareness

Environmental awareness encompasses understanding ecological issues and the fundamental relationships contributing to environmental impact (Milfont and Duckitt, 2004; Valenzuela-Fernández et al., 2022; García-Salirrosas et al., 2023; Guo and Xiao, 2023). This perspective emphasizes the importance of individual perception and knowledge concerning environmental problems, influencing subsequent behavioral choices (Xu et al., 2020; García-Salirrosas et al., 2023). As a result, environmental awareness predicts pro-environmental behavior (Kaiser et al., 1999; Omarova and Jo, 2022). It is consequently regarded as a crucial factor influencing human consumption patterns, actions, sustainability behavior, and environmental stewardship (Kaiser et al., 1999; Ali et al., 2021; Severo et al., 2021; Si et al., 2022). According to Bósquez et al. (2022), the strategic development of marketing campaigns is crucial in raising consumer awareness regarding the environmental consequences of consuming traditional products.

Previous studies have emphasized the importance of environmental awareness (Dharmaraj et al., 2021; Garg, 2021; Severo et al., 2021; Ferreira et al., 2023; García-Salirrosas et al., 2023; Valenzuela-Fernández et al., 2023). Psychological elements, such as attitudes and environmental awareness, significantly promote green consumption (Sun et al., 2019). For instance, Garg (2021) demonstrated that environmental knowledge significantly and positively influences intentions to make green purchases. On the other hand, García-Salirrosas et al. (2023) have asserted that there is an increased environmental awareness in consumption and a heightened intention to purchase environmentally friendly products in Latin American countries since the COVID-19 pandemic. Similarly, Dharmaraj et al. (2021) indicate that environmental awareness is a crucial variable in green marketing, given its direct impact on ecological purchase decisions. Furthermore, Ferreira et al. (2023) affirm that environmental awareness positively impacts the intention to recommend and behavioral intention not only in products but also in using technologies that contribute to environmental conservation.

### 2.1.3 Theory of planned behavior

Over recent decades, the theory of planned behavior (TPB) has emerged as a highly dependable and precise framework for predicting and examining individual environmental behavior (Liobikienė et al., 2016; Verma and Chandra, 2018; Gholamrezai et al., 2021; Kumar et al., 2021; Farrukh et al., 2023; Savari and Khaleghi, 2023). According to Ajzen (1991, 2020), an individual's behavior is determined by attitude, subjective norms, and perceived behavioral control. Attitude (ATT) is a theoretical framework that explains the positive or negative evaluations of cognitive beliefs about notions, persons, occurrences, or actions (Ajzen, 2002, 2015). Therefore, it may be inferred that when individuals exhibit a more favorable attitude towards specific conduct, their intention to engage in that behavior is more likely to grow (Armitage and Conner, 2001; Ajzen, 2002; Ajzen, 2020). Subjective norms (SN) communicate the social pressure on the individual to do something (Ajzen, 1991, 2020). According to Chiu et al. (2018), close relationships should influence an individual's behavior, such as family, friends, neighbors, or co-workers (Ajzen, 1991, 2020; Madden et al., 1992). Lastly, perceived behavioral control (PCB) is defined as a predictor that reflects the ease or difficulty of the individual's perception to perform a particular behavior (Ajzen, 1991; Madden et al., 1992).

## 2.2 Conceptual model and research hypothesis

The theoretical background of this study is based on the formative model (Diamantopoulos and Winklhofer, 2001). Within the specific context of this research, we have formulated six hypotheses that center on consumers' willingness to pay for green products. This proposed model provides a comprehensive framework that guides our exploration of environmental awareness influencing consumer behaviors, particularly in green product preferences. Figure 1 visually represents the relationships posited by our hypothesis, enhancing our research framework's clarity and communicative power.

### 2.2.1 Influence of environmental awareness on the theory of planned behavior

Previous studies have reported that awareness of the environment influences pro-environmental behavior (Xu et al., 2020; Valenzuela-Fernández et al., 2023). The first dimension of the theory of planned behavior is the attitude; there is evidence that indicates a positive relationship between environmental awareness and attitudes toward environmental behavior and the likelihood of individuals engaging in green purchasing (Arundati et al., 2020; Valenzuela-Fernández et al., 2022; García-Salirrosas et al., 2023; Gómez-Bayona et al., 2023; Hlaváček et al., 2023). For instance, Arundati et al. (2020) point out that individuals with a more environmentally solid awareness are more likely to acquire goods with a reduced environmental impact.

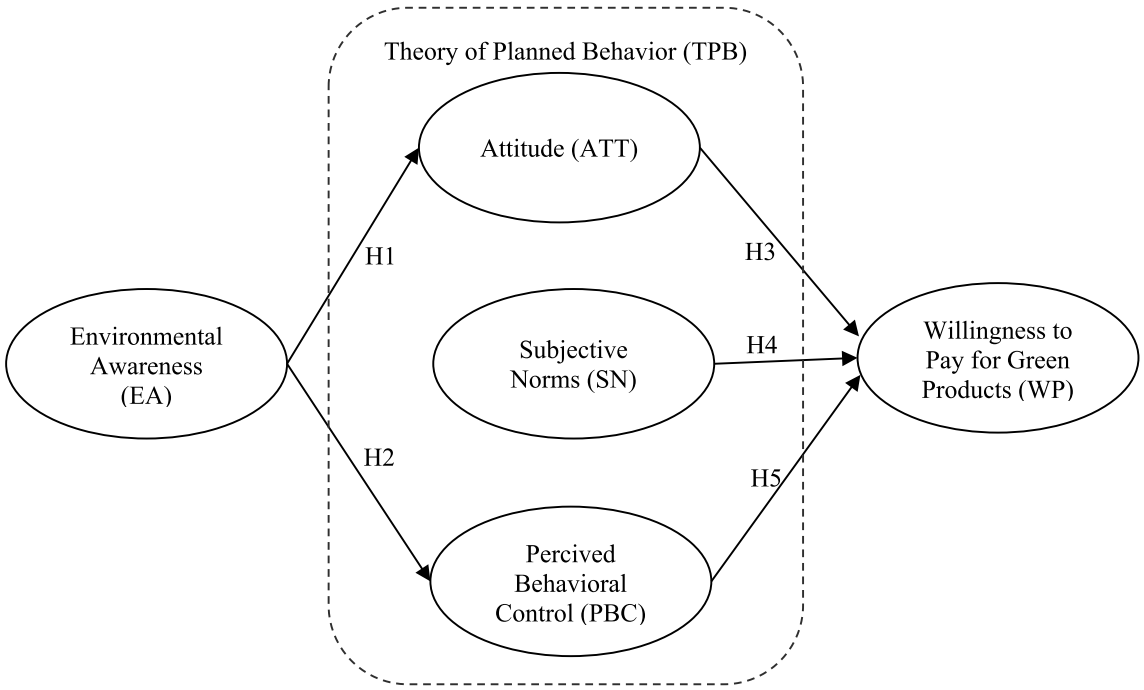


FIGURE 1
Conceptual model.

Also, Wierzbiński et al. (2021) argue that as knowledge of environmental problems increases, the likelihood of adopting ecological practices, such as a preference for purchasing organic products, increases. This perspective implies that environmental awareness is a precursor to more sustainable consumption and purchasing decisions. Additionally, the study conducted by Valenzuela-Fernández et al. (2022) has recently determined that the COVID-19 pandemic has a significant role in shaping individuals' intentions and attitudes to engage in environmentally responsible behavior. There is a pressing requirement for developing items manufactured using ecologically conscious techniques, enabling enhanced opportunities for recycling and promoting sustainable practices. Also, Hlaváček et al. (2023) have stated that awareness and attitudes encompass factors such as consciousness and concern for the environment and climate change, satisfaction with the present condition, and sufficient knowledge about environmental preservation. Based on this background, we propose the following hypothesis:

> *H1*: Environmental awareness (EA) positively influences attitudes toward the consumption of green products.

Previous literature provides evidence to support the hypothesis that environmental awareness influences perceived behavioral control in the context of consumer behavior toward green products (Nekmahmud and Fekete-Farkas, 2020; Xu et al., 2020; Nekmahmud et al., 2022; García-Salirrosas et al., 2023; Valenzuela-Fernández et al., 2023). Xu et al. (2020) suggest a favorable relationship between environmental awareness and perceived behavioral control. Their study's findings support the extensive application of the theory of planned behavior in examining consumer intentions and behaviors. Likewise, Tu and Yang (2019) emphasize that environmental conscientiousness and adopting technology products influence customers' behavioral preferences. This means that people with greater environmental awareness are inclined to incorporate environmentally friendly items into their consumption options, establishing a connection with perceived behavioral control. Ahmed et al. (2021) also found a positive relationship between perceived behavioral control and intention to purchase organic food. Environmental awareness in this context reinforces the idea that environmental knowledge and sensitivity can increase consumers' perception of control over their purchase decisions for sustainable products. In the same context, Valenzuela-Fernández et al. (2022) propose that the COVID-19 pandemic improved environmental awareness in nations such as Chile, Colombia, Peru, and Mexico. Therefore, in this case, ecological awareness supports the idea that attitude and knowing about the environment may give customers more power when choosing environmentally friendly products. Drawing upon the previously discussed background information, we propose the subsequent hypothesis:

> *H2*: Environmental awareness (EA) positively influences perceived behavioral control (PBC) for the consumption of green products.

### 2.2.2 Influence of the theory of planned behavior on willingness to pay for green products

Previous research has demonstrated that people who have a favorable attitude toward pro-environmental issues are more likely to engage in activities and actions that are beneficial to the environment (Zsóka et al., 2013; Davison et al., 2014; Bazrbachi et al., 2017; Sánchez et al., 2018; Valenzuela-Fernández et al., 2023). Ong et al. (2021) have suggested that individuals are inclined to favor and purchase environmentally friendly products in response to the COVID-19

pandemic. Kumar et al. (2021) and Valenzuela-Fernández et al. (2023) have indicated that since the beginning of the pandemic, there has been a noticeable rise in the inclination to purchase sustainable items. The potential for an enhanced inclination toward acquiring environmentally friendly items has been suggested as a factor that might contribute to an increase in the adoption of such products (Canova et al., 2020; Chen et al., 2022; Wang and Li, 2022). For example, university-age millennial consumers have very positive attitudes toward the consumption of green products when their environment significantly impacts their purchasing decisions (Bósquez et al., 2022, 2023; Hoyos-Vallejo et al., 2023). In this context, if a person has a favorable attitude toward green products, he is more likely to be willing to pay for them. Based on the above talks, the following hypothesis is put forth:

> *H3*: Attitude (ATT) positively determined the consumers' willingness to pay for green products (WP).

Secondly, subjective norms communicate the social influence pushed on an individual to perform behaviors (Ajzen, 1991; Chiu et al., 2018; Ajzen, 2020). In this sense, family, relatives, or friends should affect an individual's behaviors (Ajzen, 2002; Rehman et al., 2019; Alexa et al., 2021). In the context of consumer behavior, it is common for individuals to consider the expectations and suggestions of their social network when making environmental purchasing decisions (Xu et al., 2020; Vu et al., 2021; García-Salirrosas et al., 2023). Narwal and Nayak (2019) have pointed out that social pressure affects willingness to pay. For instance, Yadav and Pathak (2017) have stated that Subjective norm positively influences the consumer's intention to buy green products. Upon the emergence of COVID-19, some previous studies have investigated the impact on subjective norms increasing the intention of environmentally responsible behavior (Hidayat et al., 2021; Ong et al., 2021; Vu et al., 2021; Zebardast and Radaei, 2022). The pandemic has allowed people to learn about caring for the environment, and their environmental awareness has increased, resulting in social pressure for pro-environmental purchase behavior (Zebardast and Radaei, 2022). Hence, it is postulated that individuals who perceive a positive evaluation of green products within their social group are more inclined to demonstrate a willingness to pay costs for their acquisition. Based on the preceding discourse, the following hypothesis is posited:

> *H4*: Subjective norms (SN) determined the consumers' willingness to pay for green products (WP).

Thirdly, perceived behavioral control is a predictor encompassing the ease or difficulty of engaging in a specific action (Ajzen, 2020; 2002). Previous research indicates that perceived behavioral control positively influences the purchase intention and willingness to pay for eco-friendly (Lee and Back, 2007; López-Mosquera, 2016; Sánchez et al., 2018; Rehman et al., 2019; Lucarelli et al., 2020; Xu et al., 2020; Ngah et al., 2021; Vu et al., 2021). According to Sun et al. (2022), perceived control can be defined as the level of control an individual has over a particular behavior. Hence, in the context of consumption and purchase of ecological products, the greater the individual's time, resources, and opportunities, the greater their perception of control over external factors and their propensity to purchase green products. Research conducted during the period the COVID-19 pandemic has indicated a significant correlation between perceived behavioral control and the inclination to purchase sustainable and green products (Lucarelli et al., 2020; Alexa et al., 2021; Zebardast and Radaei, 2022; Valenzuela-Fernández et al., 2023). An increasing number of individuals are concerned about the preference for eco-friendly products and climate change, raising their awareness of these issues during periods of pandemics (Lucarelli et al., 2020; Severo et al., 2021; Asif et al., 2022; Valenzuela-Fernández et al., 2022; Lavuri et al., 2023). Therefore, individuals who perceive that they have control over their purchasing decisions about green products are more willing to pay for such products. Based on the previous review, this study proposes the following hypothesis:

> *H5*: Perceived Behaviour Control (PBC) determined the consumers' willingness to pay for green products (WP).

# 3 Methods

## 3.1 Contex y method

This article aimed to build a predictive model through an empirical study to examine the influence of environmental awareness (EA) on attitude (ATT), subjective norm (SN), and perceived behavioral control (PBC), as well as determine the influence of the three variables of the theory of planned behavior (TPB) on the willingness to pay (WP) for green products in the Peruvian market. The study was conducted under a quantitative approach, non-experimental, and cross-sectional design, for which a self-administered questionnaire was applied (Hair et al., 2019).

## 3.2 Sample y procedure

For the data collection of this research, a non-probabilistic convenience sampling was applied (Hair et al., 2013). For this purpose, an online survey was conducted through the Google form, the link to which was shared using the WhatsApp application. The survey was applied during the period from June 29 to September 10, 2021, in Lima city, Peru. The research was focused on consumers from 18 years of age and could be male or female. It was only necessary that each person was willing to participate, that is why in order for the respondents to participate in the survey, they were informed that their participation was voluntary, that the data collected would be analyzed anonymously and that they would be used exclusively for academic and research purposes. About 700 Peruvian consumers were invited to participate in this survey; however, only 405 fully completed questionnaires were obtained, and these were deemed legitimate for the purposes of conducting this document's statistical analyses. Of these, the largest number of participants were between 18 and 30 years old (46.2%) and their marital status were single (64.9%), and they had family income up to 2 minimum monthly wages (43.7%) (see Table 1).

## 3.3 Measurements

The construct created by Kumar et al. (2021) was employed in the development of this study model. The questionnaire was composed of

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a total of 18 items, distributed to assess attitude (3 items), social norm (3 items); perceived behavior control (3 items) and willingness to pay (3 items). and to evaluate the environmental awareness variable, the construct developed by Severo et al. (2021) was used (6 items). All items are assessed using a Likert-type scale, ranging from 1 to 5 points, where 1 means "Strongly Disagree" and 5 means "Strongly Agree." The digital questionnaire was divided into two parts. The first section presented the 18 items already mentioned, and the second section was made up of questions to collect sociodemographic data of the participants, such as age, sex, marital status, and others.

## 3.4 Data analysis

To perform the statistical analysis of the data, Partial Least Square PLS-SEM was used to test the hypotheses. PLS-SEM is a comprehensive multivariate statistical analysis approach that includes measurement and structural components to simultaneously examine the relationships between each of the variables in a conceptual model, which has the characteristic of multivariate analysis, that is, it involves a number of variables ≥3 (Hair et al., 2013). In addition, PLS-SEM was employed in the present study because it facilitates theory building (Hair et al., 2011). SmartPls (Version 4.0) was used to perform the PLS-SEM analysis.

# 4 Results

In order to evaluate with the PLS-SEM, we took two stages: (1) Evaluation of the measurement model and, (2) Evaluation of the structural model. The first moment involves assessing the validity and reliability of the measurement model, this step evaluates the relationships between each construct with its associated items and, the second moment evaluates the structural model, which deals with the relationships between the constructs (Chin, 2010; Hair Jr et al., 2014).

## 4.1 Evaluation of the measurement model

To evaluate the internal consistency of the measurement model, it was necessary to assess convergent validity and construct reliability. Convergent validity is acceptable if the loading of each indicator is >0.7 (Hair et al., 2011). A loading below 0.7 should be considered for item removal, provided that item removal allows increasing the composite reliability (CR) above 0.70 and also increasing the average variance extracted (AVE) above 0.5 (Chin, 2010; Hair Jr et al., 2014). Cronbach's alpha coefficient was also considered for reliability assessment since CR and alpha values tend to be similar when using factor-based algorithms (Kock, 2015). Table 2 shows that all loadings of the 15 items of the present construct had a value above 0.90. Also, that the Alpha and CR values of all constructs had a value higher than 0.90 and, furthermore that all AVE values were higher than 0.80; therefore, the convergent validity of the measurement model was excellent.

To assess discriminant validity, Fornell-Larker criterion was used, thus, the square root of the AVE of each construct was calculated, which had to be greater than the highest correlation between the construct and other constructs in the model (Chin, 2010; Hair Jr et al., 2014). Table 3 shows that all values in the bold diagonal are greater than the correlations. Therefore, the measurement model meets all the assumptions necessary to continue with the evaluation of the structural model.

TABLE 1 Sociodemographic data of the sample ($n$ = 405).

| | Categories | Frequency | % |
|---|---|---|---|
| Gender | Male | 162 | 40.0 |
| | Female | 240 | 59.3 |
| | I prefer not to say | 3 | 0.7 |
| Age range | 18–30 years | 187 | 46.2 |
| | 31–45 years | 125 | 30.9 |
| | 46–55 years | 58 | 14.3 |
| | 56 and over | 35 | 8.6 |
| Civil status | Married | 99 | 24.4 |
| | Cohabitant/Free union | 26 | 6.4 |
| | Divorced | 13 | 3.2 |
| | Single | 263 | 64.9 |
| | Widower | 4 | 1.0 |
| Academic level | High School/School | 115 | 28.4 |
| | Doctorate/PhD | 12 | 3.0 |
| | Specialization | 50 | 12.3 |
| | Master's degree | 42 | 10.4 |
| | Undergraduate | 160 | 39.5 |
| | Preparatory | 26 | 6.4 |
| Family income | Up to 2 minimum wages | 177 | 43.7 |
| | From 3 to 4 minimum wages | 129 | 31.9 |
| | From 5 to 10 minimum wages | 71 | 17.5 |
| | From 11 to 20 minimum wages | 19 | 4.7 |
| | Greater than 20 minimum wages | 9 | 2.2 |

## 4.2 Evaluation of the structural model

Two criteria verified the evaluation of the structural model: (a) the significance of the path coefficients and (b) the value of the R2 coefficient for the endogenous constructs. To evaluate the structural model, the path coefficients for each relationship were calculated, as well as their corresponding $p$-values. The value of the R2 coefficient depends on the field of research (Chin, 1998) suggests values of 0.67, 0.33, and 0.19 as substantial, moderate, and weak measures of R, respectively. In behavior-related studies, a value of 0.2 for R2 is considered acceptable (Kock, 2013; Hair Jr et al., 2014). In the present work, the R2 coefficients for ATT, PBC and WP were 0.472, 0.406 and 0.0.603, respectively. That is, both R2 values were at high levels. Therefore, the values show that the variables in the present study explain a high percentage of the variance in WP.

The hypothesis tests and the evaluation of the path coefficients can be seen in Table 4 and Figure 2. The results show the positive and significant effect of EA on ATT and PBC (*H1*, *H2*); also, the positive and significant effect of ATT, SN and PBC on WP (*H3*, *H4* and *H5*) was also demonstrated. In this way, all the hypotheses raised in the structural model were accepted.

TABLE 2 Assessment results of the measurement model.

| Construto | Items | Loading | (α) | CR | AVE |
|---|---|---|---|---|---|
| Attitude (ATT) | ATT1 | 0.941 | 0.928 | 0.932 | 0.875 |
| | ATT2 | 0.946 | | | |
| | ATT3 | 0.919 | | | |
| Subjective norms (SN) | SN1 | 0.870 | 0.877 | 0.879 | 0.804 |
| | SN2 | 0.927 | | | |
| | SN3 | 0.891 | | | |
| Perceived behavioral control (PBC) | PBC1 | 0.939 | 0.942 | 0.943 | 0.895 |
| | PBC2 | 0.954 | | | |
| | PBC3 | 0.946 | | | |
| Environmental awareness (EA) | EA1 | 0.723 | 0.867 | 0.876 | 0.875 |
| | EA2 | 0.671 | | | |
| | EA3 | 0.837 | | | |
| | EA4 | 0.763 | | | |
| | EA5 | 0.794 | | | |
| | EA6 | 0.859 | | | |
| Willingness to pay (WP) | WP1 | 0.951 | 0.945 | 0.945 | 0.900 |
| | WP2 | 0.946 | | | |
| | WP3 | 0.950 | | | |

Cronbach's alpha (α) for all variables is >0.8, the composite reliability (CR) >0.70, the mean–variance extracted (AVE) >0.50, indicating a significant validity of the model.

TABLE 3 Disciminant validity (Fornell-Lacker criterion).

| | ATT | EA | PBC | SN | WP |
|---|---|---|---|---|---|
| Attitude (ATT) | **0.935** | | | | |
| Environmental awareness (EA) | 0.687 | **0.777** | | | |
| Perceived behavior control (PBC) | 0.777 | 0.637 | **0.946** | | |
| Subjective norms (SN) | 0.720 | 0.557 | 0.770 | **0.896** | |
| Willingness to pay (WP) | 0.683 | 0.557 | 0.740 | 0.700 | **0.949** |

The square root of AVEs is shown diagonally in bold.

# 5 Discussion

## 5.1 General discussion

In a broad sense, the findings of the study support the notion that environmental awareness (EA) has an influence on attitude (ATT) and perceived behavioral control (PBC). Also, the theory of planned behavior encompasses three key constructs: attitude (ATT), subjective norm (SN), and perceived behavioral control (PBC). Each of these constructs influences the willingness to pay (WP) for green products within the Peruvian market.

Specifically, the first hypothesis (*H1*) has been supported. The study shows that environmental awareness (EA) plays a fundamental role in influencing attitudes towards the consumption of green products. This finding suggests that more environmentally aware people are more likely to develop positive attitudes toward purchasing and using products with a lower environmental impact. This supports the notion that environmental awareness can be a crucial driver of change towards more sustainable consumption practices. The research supports Hypothesis 2, demonstrating that environmental awareness influences perceived behavioral control. This means that more environmentally conscious people feel more empowered to make decisions supporting sustainability in their purchasing choices. This relationship between environmental awareness and perceived control could significantly affect consumer habits and promote greater alignment between intentions and actions.

According to the results of hypotheses 1 and 2, these findings have important implications for marketing and promotion strategies for green products. By understanding how environmental awareness influences consumers' attitudes and perceived behavior control, firms can adapt their approaches to encourage the adoption of sustainable products and promote environmental awareness among consumers. Furthermore, these results support the idea that environmental sustainability has become a relevant factor in consumer purchase decisions, highlighting the importance of offering green product options in the marketplace (Xu et al., 2020; Ali et al., 2021; Valenzuela-Fernández et al., 2022).

The findings of the study support the third hypothesis (*H3*), which postulates that attitudes (ATT) play a crucial role in influencing consumers' willingness to pay (WP) for green products. Specifically, the results demonstrate that favorable attitudes towards these items have a statistically significant and beneficial impact on customers' desire to pay for them. Hence, when individuals possess favorable attitudes toward environmentally friendly products, they are more inclined to pay a higher price. This highlights the significance of efforts to enhance consumer perceptions about environmental sustainability to augment the inclination to support eco-friendly items financially.

The findings mentioned in *Hypothesis 3* line up with Gomes et al. (2023) study, which looks at Generation Z's attitudes toward the higher price tags they are willing to pay for environmentally friendly products. The consumer places a lot of importance on an item's environmental attributes and is willing to pay more due to the widespread use of digital technology, increased environmental awareness, and a strong emphasis on sustainability.

The fourth hypothesis (*H4*) focused on investigating the potential impact of subjective norms (SN) on customer willingness to pay for green products (WP). The test findings suggest a statistically significant and positive correlation between personal norms and individuals' willingness to pay. This finding implies that customers' social perceptions and expectations within their immediate surroundings impact their inclination to pay more for environmentally friendly items. In essence, when individuals perceive that their societal context places importance on and provides backing for acquiring environmentally sustainable products, they demonstrate a greater inclination to pay extra costs to get these products.

The results of *Hypothesis 4* match prior research, which affirms that there is a positive correlation between social factors and the preference towards adopting environmentally responsible behavior (García-Salirrosas et al., 2023; Valenzuela-Fernández et al., 2023). This finding provides an opportunity to evaluate the influence of personal norms on the willingness to pay for green products.

Finally, the fifth hypothesis (*H5*) was examined to determine the potential impact of perceived behavioral control (PBC) on customers' willingness to pay for green products (WP). The research results show a statistically significant link between perceived behavioral control (PBC) and willingness to pay (WP), which supports the hypothesis. This implies that the degree to which consumers believe they have control over their

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TABLE 4 Hypothesis testing.

| H | Hypothesis | Original sample (O) | Sample mean (M) | Standard deviation (STDEV) | T statistics (\|O/STDEV\|) | *p* values | Decision |
|---|---|---|---|---|---|---|---|
| *H1* | EA –> ATT | 0.687 | 0.688 | 0.031 | 22.242 | 0.000 | Supported |
| *H2* | EA –> PBC | 0.638 | 0.639 | 0.033 | 19.208 | 0.000 | Supported |
| *H3* | ATT –> WP | 0.191 | 0.191 | 0.074 | 2.575 | 0.010 | Supported |
| *H4* | PBC –> WP | 0.391 | 0.390 | 0.069 | 5.703 | 0.000 | Supported |
| *H5* | SN –> WP | 0.260 | 0.263 | 0.079 | 3.291 | 0.001 | Supported |

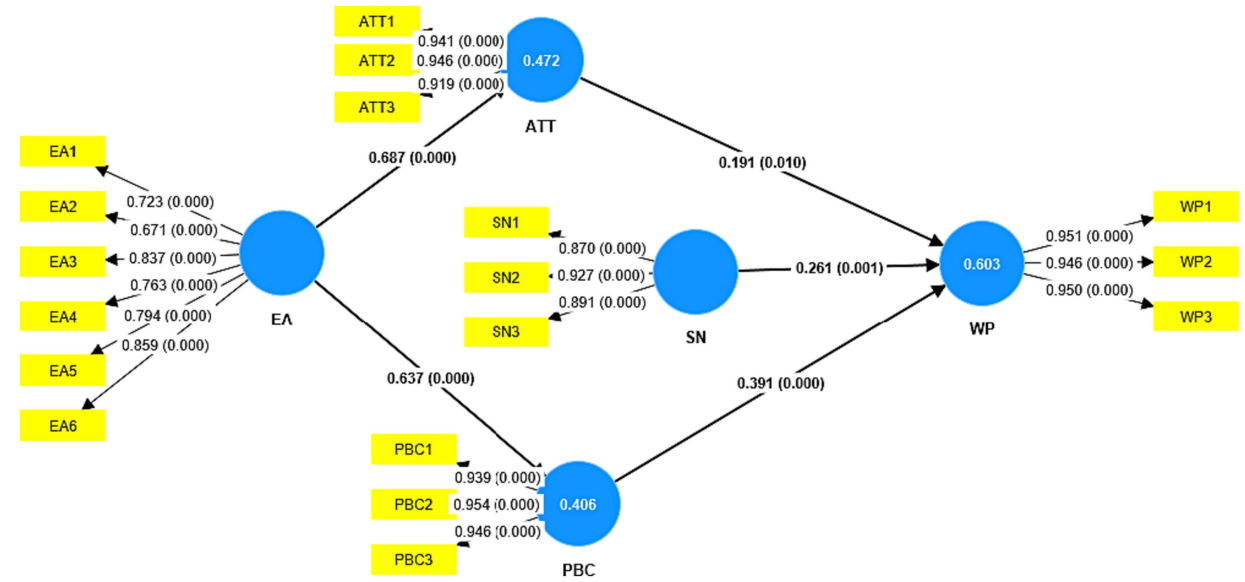


FIGURE 2
Structural model.

capacity to make purchasing choices for environmentally friendly items impacts their willingness to pay a higher price for such products. The perception of being well-informed and able to influence their sustainable purchasing decisions is a driving force behind their willingness to pay a higher fee for environmentally friendly items.

In addition, these results of Hipotesis 5 align with earlier research that shows how important perceived behavioral control (PBC) is for consumers to form long-lasting buying habits, as shown in the study by Shi and Jiang (2023). Additionally, research by Peluso et al. (2021) and Alexa et al. (2021) supports the growing trend toward the adoption of sustainable and environmentally friendly products.

Finally, the findings are congruent with sustainable practices within the Latin American context. There has been an observed change in consumer perception, resulting in a corresponding rise in demand (Madrigal-Moreno et al., 2021; Severo et al., 2021; Valenzuela-Fernández et al., 2022). Hence, an extensive understanding of customers' buying intentions could help local manufacturers formulate efficacious tactics to enhance their competitiveness within the market (González-Cabrera and Trelles-Arteaga, 2021; García-Salirrosas and Rondon-Eusebio, 2022; Gómez-Bayona et al., 2023). The interactions between consumers and brands are important in forecasting product and service purchases and purchase intentions. Therefore, effective information management significantly influences consumer decision-making and the consumption patterns of certain items (Lopes et al., 2023).

## 5.2 Implications

In the post-pandemic society, consumers are increasingly aware of environmental issues and are more willing to pay for products perceived as sustainable when environmental awareness is actively promoted (Moorthy et al., 2023). However, purchasing decisions remain uncertain (Kim and Lee, 2023). Therefore, the results obtained in this study may have implications in the field of marketing and brand positioning, as consumers can make more informed purchasing decisions by aligning their environmental values with their consumption choices as evidenced in the literature.

Companies can take advantage of this knowledge by developing marketing strategies that highlight the sustainable aspects of their products and align with the values of environmentally conscious consumers. Peruvian companies can use these results to design specific information campaigns and promote sustainable practices in their markets, which would improve local producers' competitiveness. In particular, the results contribute to Peruvian industries and can be replicated and adapted to other geographical contexts.

Furthermore, businesses and public institutions must promote environmental education and awareness. Because environmental awareness can directly impact shaping a more sustainable society in its consumer choices, consumers aware of the effects of green consumption are more willing to pay for them. From a policy and regulatory perspective, this study supports the need to implement policies that promote sustainability and environmental responsibility. Promoting the creation and use of green products could cause a big change in how people consume products in a way that is better for the environment. This supports the idea that people need to be more aware of the environment for responsible and long-lasting consumption habits to spread, which is good for everyone and the environment. The results contribute to the discourse on building a more environmentally conscious and responsible society, thus promoting a sustainable consumption model. Likewise, policymakers and environmental organizations can use these results to promote awareness of sustainable consumption patterns.

# 6 Conclusión

This study has effectively shown the significant impact of environmental awareness on consumer behavior and its influence on willingness to pay for green products in the Peruvian market. Based on the theory of planned behavior, the study shows that being aware of the environment positively affects your attitudes and perceived behavior control. The research results show a statistically significant link between these critical factors and environmental awareness. This shows how consumers can be more willing to pay for eco-friendly products. For this reason, environmental awareness improves transformative consumer practices, fostering sustainability and ecological responsibility. Because of this, a consumer who cares about the environment is likely to carefully think about how a product is made, how it is distributed, what it is made of, and how it affects sustainability, reusability, and climate change.

This model provides empirical evidence for the impact of environmental awareness on consumer behavior, specifically in purchasing decisions and willingness to pay for environmentally friendly items. Notably, environmentally responsible behavior emerges as a pivotal element shaping consumer willingness to pay for green products, aligning with the findings of Kaiser et al. (1999) and Omarova and Jo (2022). Recent events, like COVID-19, have made this trend stronger. As noted in the literature review, previous studies have shown that people want more organic and health-promoting products with eco-friendly features and high-quality materials.

This underscores the evolving consumer landscape, where environmental considerations are increasingly integral in shaping purchasing decisions, reflecting a growing consciousness towards sustainability and health in the Peruvian market. Furthermore, the aftermath of COVID-19 has amplified these effects, with health and well-being concerns further motivating consumers to favor environmentally friendly options, even at higher prices. Social norms also come into play, as positive attitudes towards sustainability correlate with an increased willingness to pay for eco-friendly products.

## 6.1 Limitations and future research

This research should consider some limitations for future research. The first refers to the type of sampling, which is non-probabilistic and transversal and includes only consumers from Peru, which could limit the conclusions obtained and the generalizability of the study results. Secondly, the data collection method was conditioned by the limitations of COVID-19. The study was conducted through an online survey in which participants responded voluntarily, which did not allow the evaluation of consumer behavior in real-time. Third, the temporality of the study, by not allowing the results to be extrapolated to post-pandemic scenarios, makes it possible to explore opportunities for future studies that evaluate the evolution of COVID-19 in post-pandemic scenarios. A final limitation that suggests observing the generalization of the study's conclusions is related to the honesty in the responses of individuals, a product of social pressure and ethics related to issues of environmental interest.

This study makes it possible to provide preliminary information on consumer behavior for future studies of gaps between purchase intention and purchase experience, considering that many of the consumers who declare their intention to purchase sustainable products commonly end up not buying them (Severo et al., 2021; Valenzuela-Fernández et al., 2022; García-Salirrosas et al., 2023; Valenzuela-Fernández et al., 2023).

# Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

# Author contributions

EEG-S: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. ME-F: Conceptualization, Investigation, Resources, Validation, Writing – original draft, Writing – review & editing. LG-B: Investigation, Resources, Supervision, Validation, Visualization, Writing – original draft. GM-L: Conceptualization, Investigation, Project administration, Resources, Writing – review & editing. AV-A: Conceptualization, Project administration, Resources, Supervision, Visualization, Writing – original draft, Writing – review & editing. RG-C: Conceptualization, Funding acquisition, Project administration, Resources, Supervision, Validation, Visualization, Writing – review & editing.

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# Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



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# Abstract or concrete? The impact of regional typicality and advertising appeal types on consumption intention toward geographical indication products

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The essential characteristic of geographical indication products is the association of the products with their region of origin. However, consumers have different associations between products and their region of origin (i.e., different regional typicality) according to different geographical indication products. In this regard, this research aims to explore how to adopt supporting advertising appeal types to improve consumers' attitudes and intentions toward geographical indication products with different regional typicality. To this end, this article proposes and tests the interaction between regional typicality and advertising appeal types on consumption intention toward products and the underlying mechanism and boundary conditions of this effect. Using three studies, this research finds that the adoption of abstract (vs. concrete) appeal is more likely to enhance consumption intention toward products when the geographical indication products have high regional typicality. Moreover, the reverse is true when the geographical indication products have low regional typicality. Furthermore, the results show that processing fluency mediates the interaction effect. In addition, the high (low) regional typicality and abstract (concrete) appeal on consumption intention toward products are more significant in the distant (close) spatial distance condition. In this way, this research provides a new perspective for studying consumer behavior with respect to geographical indication products and has implications for promoting the sales of geographical indication products and enhancing the brand value of geographical indication.

KEYWORDS

**geographical indication products, regional typicality, advertising appeal types, processing fluency, spatial distance, consumption intention**

## 1 Introduction

According to the World Intellectual Property Organization, geographical indication is a sign used on products with a specific geographical origin that references the qualities or reputation created by that origin[1]. Accordingly, a product named according to a geographical name refers to a geographical indication product, such as prosciutto di Parma (Italy), Kalamata olives (Greece), and Yantai apple (China). Geographical indication products have a close relationship with their region of origin since the quality, characteristics, or reputation of the products essentially depend on these regions.

1 https://www.wipo.int/geo_indications/en/

A specific category of products might be attributed to multiple origins in China due to its various regions with diversities and similarities in terms of the natural environment and humanistic history. For this reason, different regions might include multiple geographical indication products of the same category. For example, when it comes to rice, there are varieties such as Wuchang rice, Jinci rice, Longmen rice, and others. When it comes to apple, there are various options available, including Yantai apple, Jinzhou apple, Yuncheng apple, and more. Although they belong to geographical indication products of the same category, they originate from different regions. Objectively, geographical indication products are closely and positively linked to their region of origin. However, consumers have different associations between these products and their region of origin due to stereotypes or insufficient publicity, resulting in the formation of different forms of "regional typicality." Regional typicality refers to the positive association that consumers establish between products in a certain category and a particular region within the same country. For example, when compared to "Jinci" and "rice," the correlation between "Wuchang" and "rice" is stronger, making it easier for consumers to establish a specific association between "Wuchang" and "rice." As a result, "Wuchang rice" exhibits a higher regional typicality, while "Jinci rice" demonstrates a lower regional typicality. Similarly, compared with "Jinzhou" and "apple," it is easier for consumers to establish a specific association between "Yantai" and "apple." As a result, the regional typicality of "Yantai apple" is higher, while that of "Jinzhou apple" is lower. Consumers have varying perceptions and preferences for geographical indication products with different regional typicality. Especially for geographical indication products with low regional typicality, most consumers are not familiar with them, which fails to stimulate their positive attitudes and consumption intentions. Hence, it is necessary to explore how to cultivate consumers' positive attitudes and consumption intentions toward geographical indication products with different regional typicality. Answering this question can provide insights into enhancing the brand value of geographical indications and promoting the balanced development of the geographical indication industry.

Previous studies have focused on two aspects of geographical indications and geographical indication products. One aspect is the analysis of the classification, identification, function, certification, and protection of geographical indication labels at the macro-level (Menapace et al., 2011; Lans et al., 2013; Geuens et al., 2021). The other aspect is the micro-level discussion of consumers' cognition and evaluation of geographical indication products (Loureiro and Mccluskey, 2000; Aprile et al., 2012) and the influence of origin factors and consumer characteristics on the purchasing behavior of geographical indication products (Bonnet and Simioni, 2001; Loureiro and Umberger, 2007; Likoudis et al., 2016; Luceri et al., 2016). However, few studies have classified geographical indication products to explore consumer behavior regarding geographical indication products of different types (Zhang et al., 2022), specifically from the perspective of "regional typicality." Thus, an investigation of consumer intention and behavior is crucial regarding geographical indication products from the perspective of "regional typicality" due to the importance of the origin of geographical indication products.

In the market, more and more marketers are using advertising strategies to cultivate consumers' positive attitudes and consumption intentions toward products. For example, they use different advertising appeal types to highlight the core message of product-related attributes in order to persuade or impress the audience of the advertisement (Holbrook and Batra, 1987). Specifically, advertising the region of origin of geographical indication products has not only an abstract appeal that uses vague and subjective descriptions to highlight macroscopic and holistic features, but it also has a concrete appeal that uses specific and objective descriptions to highlight detailed and concrete features. However, it is not clear what types of advertising appeal should be adopted for the region of origin features of geographic indication products with different regional typicality. Therefore, this research considers the region of origin of geographical indication products as the advertising target to explore the interaction between regional typicality (high vs. low) and advertising appeal types (abstract vs. concrete) on consumption intention toward products. Moreover, this research explores the underlying mechanism and boundary conditions of this interaction effect. In this way, this research contributes to the literature on consumer behavior in relation to geographical indication products and the matching effect of advertising appeals. In addition, this research provides implications for improving the sales and brand value of geographical indication products and promoting the balanced development of the geographical indication industry.

The remainder of this article is organized as follows: First, this research reviews prior research on typicality and abstract and concrete appeals and develops the research hypotheses. Then, it tests these hypotheses through three main experimental studies. Finally, it discusses the theoretical contributions, practical implications, and limitations of the research and presents possible directions for future research.

## 2 Conceptual background and hypothesis development

### 2.1 Typicality and regional typicality

The typicality theory proposes that the most typical members of categories are those having the most attributes in common with other members of that category and the least attributes in common with other categories (Rosch and Mervis, 1975). Previous studies show that the more a stimulus object has the core features of the corresponding category, the more typical it is (Loken and Ward, 1990). Hence, typicality is the degree to which it has overlapping attributes. Product typicality refers to the extent to which features of a product overlap with those commonly found in the category. In other words, product typicality indicates how much a product is representative of its product category (Loken and Ward, 1990; Ozanne et al., 1992). For example, apple and pomegranate are perceived as high and low typical fruits, respectively, since apple is more likely to be deemed as a representative of fruits than pomegranate. Categorization literature has identified several antecedents of typicality perception. One antecedent is family resemblance, which refers to the degree to which a category member has attributes in common with other

category members (Mervis and Rosch, 1981). Another antecedent is the frequency of instantiation, where frequently encountered product options are considered to be more typical of the category (Loken and Ward, 1990).

Usunier and Cestre (2007) introduce typicality into the study of country of origin and propose the "product ethnicity" to reflect a strong association between a product and a country, which is a form of typicality. Furthermore, Wang et al. (2013) define the concept of "country typicality" as establishing positive associations between a certain country and a specific product by consumers. In general, different categories of products have different country typicality for the same country. For example, the country typicality of "Swiss timepieces" is higher than that of "Swiss car." In addition, the same categories of products have different country typicality for different countries. For example, the country typicality of "French wine" is higher than that of "Indian wine." This stereotype or positive association between a product and its country of origin is reflected not only at the country level but also at the level of different regions within the country. For example, Chinese people associate peony with Luoyang and rice with Wuchang. Therefore, inspired by "country typicality," the term "regional typicality" refers to the positive association between products of a certain category and a specific region within the same country established by consumers.

China has a vast area where differences and similarities in natural environment and humanistic history coexist among different regions. Thus, different regions might include multiple geographical indication products of the same category, such as Gannan navel orange and Linshui navel orange. However, consumers perceive rather different associations between the product and its region of origin for these geographical indication products, which leads to regional typicality differences. For example, compared with "Linshui" and "navel orange," consumers are more likely to establish a specific association between "Gannan" and "navel orange." Therefore, Gannan navel orange has high regional typicality, while Linshui navel orange has a low one. Regional typicality based on consumer stereotypes could affect consumers' cognition of geographical indication products and thus affect their purchase intention.

## 2.2 Abstract and concrete advertising appeals

Marketers commonly use abstract appeal and concrete appeal as two kinds of advertising strategies to motivate individual consumption intention and behavior. Abstract appeal expresses abstract and macroscopic information, usually focusing on the holistic evaluation of the product, ignoring the detailed features. Specifically, abstract appeal includes vague and abstract wording and describes the features of products in a more subjective and unspecific way (Leonidou et al., 2011; Yang et al., 2015). In contrast, concrete appeal expresses concrete and specific information, usually focusing on the description of relevant product details for more tangible and easier imagination. Specifically, concrete appeal contains detailed and concrete information and describes the features of products in a more objective and specific way (Leonidou et al., 2011; Yang et al., 2015). These two distinctive appeals can describe the origin features of geographical indication products: 1- abstract appeal (e.g., beautiful scenery, beautiful environment, and unique ecological conditions) and 2- concrete appeal (e.g., tall mountains and many trees, pollution-free water, and soil of high organic matter content).

Different advertising appeal types may diversify individuals' different information cognition and processing patterns, leading to their different consumption intentions. Abstract appeal and concrete appeal have different effects on individuals' judgments and decisions. Many studies confirm the greater impact of concrete appeal than abstract appeal on consumers' judgments and decisions because it is more vivid and can attract the attention of more consumers (Moeser, 1974; Holmes and Langford, 1976; Ford et al., 1990; Darley and Smith, 1993). However, other studies find that the effect of abstract appeal is stronger than that of concrete appeal (Fong and Nisbett, 1991). In addition, existing research has discussed the effects of abstract appeal and concrete appeal in different situations. Kim et al. (2009) indicate that temporal distance determines the relative effectiveness of abstract appeal and concrete appeal. In other words, abstract (concrete) appeal is more persuasive than concrete (abstract) appeal when voters' decisions are temporarily distant (imminent). Yang et al. (2015) find that the beneficial association of green products affects the effectiveness of abstract vs. concrete appeal. Concretely, abstract appeals can induce green purchase intention more than concrete appeals when the attributes of green products are related to the benefit of others. However, both appeal types seem to be less effective when the attributes of green products are related to the benefit of the self. Yang et al. (2018) contend that the specificity of search keywords determines the effects of abstract and concrete appeals in advertising for organic food. Specifically, abstract (vs. concrete) appeal could improve advertisement performance when consumers search for generic keywords without organic claims; the reverse is true when consumers search for specific keywords with organic claims. Ku (2021) proposes the relative role of individual characteristics in abstract and concrete appeals, that is, consumers with independent (interdependent) self-view are more likely to be persuaded by abstract (concrete) appeal. To sum up, abstract and concrete appeals have different effects in different consumption situations, which need further exploration.

## 2.3 Consumer behavior concerning geographical indication products

With the increase in consumer income and the growing emphasis on product safety, high quality, and variety, consumers are increasingly preferring products with geographical indications and are willing to pay a premium for them (Loureiro and Mccluskey, 2000; Aprile et al., 2012; Garcia et al., 2023). What factors have influenced consumer behavior toward geographical indication products? Existing research mainly analyzes this from the perspectives of the region of origin, geographical indication labels, and individual characteristics.

The first aspect is the region of origin. Existing research has extensively discussed the influence of a product's region of origin on consumer preferences and purchasing decisions for geographical

indication products (Artencio et al., 2023; Zhe et al., 2023). Van der Lans et al. (2001) find that the cues of the region of origin indirectly affect consumers' preferences and purchasing decisions for regional products through perceived quality and directly influence the preferences and purchasing decisions of specific consumer groups for regional products. Resano et al. (2012) indicate that while the PDO scheme attracts a segment of consumers, the region of origin in itself is still a more powerful signal of quality. Luceri et al. (2016) investigate a significant main effect of the region of origin presentation on brand attitude and purchase intention toward EU geographical indication quality label products. In summary, providing the region of origin can reassure consumers about the origin and production methods of geographical indication products. This can help reduce perceived risks in consumption, leading to positive product preferences and purchase intentions among consumers.

The second aspect concerns geographical indication labels. Marketing research indicates that consumers' product choices depend on their perception of internal and external characteristics (Goldstein et al., 2008). Geographical indication labels are considered a crucial tool for consumers to connect the overall quality of a product with its region of origin, particularly in terms of external characteristics. Geographical indications labels not only represent the unique characteristics of products from a specific region but also indicate the production standards (Menapace et al., 2011). This significantly reduces the information asymmetry between producers and consumers and lowers consumers' search costs (Loureiro and Mccluskey, 2000; Aprile et al., 2012). Therefore, there is evidence that consumers' perceptions of product quality and their preferences are influenced by geographical indication labels (Van Ittersum et al., 2007; Rabadán et al., 2021; Milkovic et al., 2023). Geographical indication labels play a crucial role in influencing consumers' purchasing decisions.

The third aspect relates to individual characteristics. Individual characteristics are also important factors that influence the preference and purchasing decisions of geographical indication products. Current research indicates that sociodemographic characteristics, such as gender, age, income, education level, and family size, can influence consumer preferences and purchasing decisions (Krystallis and Ness, 2005; El Hadad-Gauthier et al., 2022). In addition, personal beliefs, consumption habits, risk preferences, emotional tendencies, culture, and historical experiences also influence consumers' attitudes and willingness to pay a premium for geographical indication products (Fernández-Ferrín et al., 2019; Maró et al., 2023).

From the literature review above, previous research has primarily focused on examining the impact of the region of origin, geographical indication labels, and individual characteristics on consumers' attitudes, preferences, and purchasing behaviors toward products. However, there is limited literature that categorizes research from the perspective of the association features between geographical indication products and their region of origin, i.e., regional typicality. That is, categorizing geographical indication products into high and low regional typicality categories for study. Therefore, this research will integrate various advertising appeals to examine individual consumption intentions for geographical indication products with different regional typicality.

## 2.4 Interaction between regional typicality and advertising appeal types

Selecting the appeal types of advertisements that match product features could maximize their persuasion effect (Johar and Sirgy, 1991; Zhang and Gelb, 1996). Regarding the origin features of geographical indication products with different regional typicality, adopting the advertising appeal matching their features is more likely to be persuasive and win consumers' preference and consumption intention. For geographical indication products with high regional typicality, consumers easily establish a positive association between the product and its region of origin, implying the connection of the product with most people and reflecting the consumers' general perception. Existing research claims that consumers mainly prefer typicality since it makes product identification easier (Loken and Ward, 1990; Veryzer and Hutchinson, 1998), and the fact that a number of people prefer or have purchased the product suggests that the product must be good (Deval et al., 2012; Wu and Lee, 2016). Based on this, consumers have formed a relatively macroscopic and holistic perception and evaluation of the geographical indication products with high regional typicality. Compared with concrete appeal, abstract appeal focuses on using vague and subjective ways to describe macroscopic and holistic information. This kind of abstract and holistic evaluation information is conducive to consumers' rapid accessibility and formation of the overall quality perception of the product (Lichtenstein and Srull, 1987). Hence, high regional typicality is matched with abstract appeal. Adopting abstract appeal for geographical indication products with high regional typicality could meet consumers' basic demand for product quality and then complete product evaluation and decision. Conversely, the adoption of concrete appeal will increase the perceptive difficulty and cognitive load of ordinary consumers, which makes it harder for working memory to initiate cognitive processing (Schnotz and Kurschner, 2007). Therefore, in the context of high regional typicality, adopting abstract appeal will increase the persuasiveness of advertising to consumers and enhance their preference and consumption intention toward such products.

On the contrary, consumers hardly perceiv e a positive association between a product and a specific region from their memory in the case of geographical indication products with low regional typicality. This circumstance implies that consumers lack a holistic perception and evaluation of the product. Compared with abstract appeal, concrete appeal focuses on describing product details and is more diagnosable due to its more tangible and easier imagination. This comparison implicitly shows that concrete appeal has a higher degree of correlation with consumers' judgments and decisions, which is more conducive to consumers' matching evaluations of product information to make purchase decisions. Conversely, the low diagnosability of abstract appeal causes a certain risk, which makes it difficult for consumers to make decisions and thus reduces their consumption intention toward advertised products (Petersen and Kumar, 2015). Therefore, the adoption of concrete appeal will help consumers to accurately evaluate product quality and enhance their consumption intention for geographical indication products with low regional typicality

of which consumers lack holistic perception and understanding. Consequently, this article proposes the following hypotheses.

**H1:** There is a significant interaction between regional typicality and advertising appeal types on consumption intention toward products.

**H1a:** When regional typicality is high, compared with concrete appeal, adopting abstract appeal will make consumers have higher consumption intention toward geographical indication products.

**H1b:** When regional typicality is low, compared with abstract appeal, adopting concrete appeal will make consumers have higher consumption intention toward geographical indication products.

## 2.5 Mediating role of processing fluency

Processing fluency refers to an individual's subjective experience of the ease with which information is processed during a decision (Schwarz, 2004; Oppenheimer, 2008; Northey and Chan, 2020). In the decision-making process, individuals are not only affected by the objective information content but also by the subjective feelings brought by the information. The information of various ways of wording or description may bring different subjective perceptions to individuals. When the information is matched with the target, motivation, and processing pattern of the audience, the information will be more easily understood and perceived as an important item, resulting in higher processing fluency (Aaker et al., 2000). Based on previous studies, processing fluency decreases the required time and effort of individuals in the short term and increases the accuracy of information identification (Reber et al., 2004; Wurtz et al., 2008).

Considering the context of this research, when regional typicality is high, consumers have a macroscopic and holistic perception and evaluation of geographical indication products, which matches the subjective and holistic evaluation information described by the abstract appeals. Based on previous studies, consumers easily understand the information, and experience high processing fluency, if exposed to information or stimuli that match their mental representation or motivation (Labroo and Lee, 2006; Kim and John, 2008). Therefore, the adoption of abstract appeal in high regional typicality conditions will lead to higher processing fluency for consumers. Similarly, consumers lack a holistic perception and evaluation of geographical indication products if the regional typicality is low. In this case, concrete appeal that focuses on detailed and specific information could help consumers to accurately complete their judgment and decision. Therefore, the adoption of concrete appeal that matches the low regional typicality will trigger high processing fluency for consumers. In addition, prior research indicates that higher processing fluency positively affects the persuasive effect of advertising and the quality perception, attitude, and consumption intention and behavior of a product (Chandrashekaran and Grewal, 2003; Novemsky et al., 2007; Chae and Hoegg, 2013; Brylla and Walsh, 2020; Jiang et al., 2020). Therefore, the high processing fluency caused by the matching of regional typicality (high vs. low) and advertising appeal types (abstract vs. concrete) will lead to high consumption intention toward geographical indication products. Consequently, this article proposes the following hypothesis.

**H2:** Processing fluency mediates the interaction between regional typicality and advertising appeal types on consumption intention toward geographical indication products.

## 2.6 Moderating effect of spatial distance

In different forms of regional typicality, consumers' preferences for advertising appeal types will also be affected by the spatial distance from the region of origin. Construal level theory proposes that people's perception preferences and behavioral responses to events or objects are influenced by psychological distance, including temporal distance, spatial distance, social distance, and hypotheticality (Trope and Liberman, 2010). Various psychological distances cause different construal levels and individual judgment and decision. Specifically, when individuals perceive the psychological distance of events or objects as distant, they are accustomed to using a high construal level to represent them. The high construal level is abstract, holistic, primary, superior, essential, and goal related. Conversely, when individuals perceive the psychological distance of events or objects as close, they are accustomed to using a low construal level to represent them. The low construal level is concrete, partial, subordinate, inferior, superficial, and goal unrelated (Trope and Liberman, 2003). Another factor is spatial distance as a dimension of psychological distance, which affects an individual's cognitive judgment and behavioral decision by changing the individual's construal level representation. According to previous studies, individuals are more likely to adopt a high (low) construal level (i.e., abstract (concrete) thinking) to make a judgment and decision when the actions or events occur at a distant (close) spatial distance (Fujita et al., 2006; Henderson et al., 2011; Kim et al., 2019).

Considering the context of this research, when the spatial distance between consumers and region of origin is distant regarding geographical indication products, they are more likely to adopt high construal level representations, and thus, they prefer an abstract appeal that matches with high regional typicality. On the contrary, when this spatial distance is close, they are more likely to adopt low construal level representations, and thus, they prefer a concrete appeal that matches with low regional typicality. Kim et al. (2016) have found that when advertising appeal types are consistent with consumers' psychological distance to objects, they are more likely to have a positive evaluation and consumption intention of the advertising brand. Therefore, adopting abstract appeal for geographical indication products with high regional typicality is more likely to trigger positive consumption intention in the distant spatial distance condition, while adopting concrete appeal for geographical indication products with low regional typicality is more likely to trigger positive consumption intention in the close spatial distance condition. Consequently, this article proposes the following hypotheses.

**H3:** Spatial distance moderates the interaction between regional typicality and advertising appeal types on consumption intention toward products.

**H3a:** When the spatial distance between consumers and region of origin is distant, high regional typicality and abstract appeal

have a more significant effect on consumption intention toward geographical indication products.

**H3b:** When the spatial distance between consumers and region of origin is close, low regional typicality and concrete appeal have a more significant effect on consumption intention toward geographical indication products.

# 3 Overview of studies

This article reports the empirical tests of the research hypotheses, including one pretest and three studies. The pretest selects appropriate stimulus products with high or low regional typicality for the other three studies. The three studies test the research hypotheses by using different stimulus products (apple, tea, and oyster) and dependent variables (purchase intention, willingness to pay a price premium, and recommendation intention). Study 1 provides initial evidence for the hypotheses by showing that abstract (concrete) appeal could improve consumers' purchase intention for geographical indication products with high (low) regional typicality (Hypotheses 1, 1a, and 1b). Then, Study 2 replicates the findings of Study 1 and further explores the underlying mechanism, suggesting that processing fluency plays a mediating role in the effect (Hypothesis 2). Finally, Study 3 demonstrates the moderating effect of spatial distance (Hypotheses 3, 3a, and 3b).

## 3.1 Pretest

### 3.1.1 Method

This pretest selected "Yantai apple," "West Lake Longjing tea," and "Rushan oyster" as geographical indication products of high regional typicality and "Rushan apple," "Rongcheng green tea," and "Zhuanghe oyster" as geographical indication products of low regional typicality. A total of 72 participants were randomly assigned to two groups. According to the definition of regional typicality, we set up a two-item question to measure participants' perception of regional typicality: (a) "When it comes to apple, I am associated with Yantai (Rushan) easily" and (b) "I think Yantai (Rushan) apple is of good quality" (1 = strongly disagree to 7 = strongly agree).

### 3.1.2 Results

The results of an ANOVA showed that when it came to "apple," participants were likely to associate more with "Yantai" than "Rushan" ($M_{Rushan} = 3.583$, $SD = 1.795$; $M_{Yantai} = 5.583$, $SD = 1.339$; $F(1,70) = 28.718$, $p<0.001$). Moreover, participants thought that "Yantai apple" had a higher quality than "Rushan apple" [$M_{Rushan} = 4.528$, $SD = 1.404$; $M_{Yantai} = 5.778$, $SD = 0.989$; $F_{(1,70)} = 19.078$, $p < 0.001$]. The results indicated that for "Yantai apple," consumers established a positive association between the product and the region. Therefore, "Yantai apple" can be used as a product of high regional typicality. On the contrary, "Rushan apple" can be used as a product of low regional typicality. Similarly, "tea" and "oyster" showed analogous results. The former results were as follows: [association: $M_{Rongcheng} = 3.806$, $SD = 1.939$; $M_{WestLake} = 5.778$, $SD = 1.149$; $F_{(1,70)} = 27.555$, $p < 0.001$; Quality: $M_{Rongcheng} = 4.750$, $SD = 0.996$; $M_{WestLake} = 5.889$, $SD = 1.063$; $F_{(1,70)} = 21.994$, $p < 0.001$]. The latter results were as follows: [association: $M_{Zhuanghe} = 3.944$, $SD = 1.492$; $M_{Rushan} = 5.417$, $SD = 1.339$; $F_{(1,70)} = 19.418$, $p < 0.001$; Quality: $M_{Zhuanghe} = 4.861$, $SD = 0.990$; $M_{Rushan} = 5.750$, $SD = 0.996$; $F_{(1,70)} = 14.417$, $p < 0.001$]. In conclusion, the selected geographical indication products were appropriate to be used as stimulus materials.

## 3.2 Study 1

Study 1 provided initial support for the proposed interaction effect between regional typicality and advertising appeal on consumption intention toward geographical indication products. This study used purchase intention as the dependent variable to measure consumption intention and predicted that abstract (concrete) appeal could improve consumers' purchase intention for geographical indication products with high (low) regional typicality.

### 3.2.1 Method

#### 3.2.1.1 Participants

A total of 224 Wjx.com[2] participants were recruited and randomly assigned to one of four conditions in a 2 (regional typicality: high vs. low) ×2 (advertising appeal: abstract vs. concrete) between-subjects design. Then, we excluded 17 participants who failed the attention check, leaving 207 responses (107 female participants; $M_{age} = 25.66$) for subsequent analyses.

#### 3.2.1.2 Procedure

This study used variations of "apple" as stimulus products, among which "Yantai apple" and "Rushan apple" were the products of high and low regional typicality, respectively. Choosing "apple" as the stimulus product was mainly based on the following two reasons. Firstly, participants were familiar with "apple" and often buy it since this fruit is relatively common in daily life. Secondly, apple had an obvious high or low regional typicality, which is adequate for manipulation.

First, participants were briefly introduced to the product and shown its corresponding advertising appeal. Under abstract appeal condition, participants were shown abstract information about the region of origin. The example was as follows: "The region of origin has beautiful scenery, pleasant climate, and a good ecological environment. The advantaged geographical location and unique natural endowment provide excellent planting and growth conditions for the Yantai apple." Under concrete appeal condition, participants were shown concrete information about the region of origin. The example was as follows: "The region of origin is located in the nature belt of gold near 38 degrees North latitude. In this location, the temperature difference between day and night is large, the annual sunshine time is about 2600 h, the frost-free period is more than 200 days, and the soil has high organic matter content, which is very proper for planting Yantai apple." Then, participants

2 The sitewjx.com is one of the most popular online survey platforms in China.

were asked to answer the manipulation check questions about abstract and concrete appeals: (a) "To what extent is this an abstract appeal (i.e., describes the features of the region of origin in a general and vague way)?" and (b) "To what extent is this a concrete appeal (i.e., describes the features of the region of origin in a specific and detailed way)?" [1 = not at all to 7 = very much; adapted from White and Simpson (2013), Yang et al. (2015)]. Participants were asked to answer a three-item question about purchase intention toward the product subsequently: (a) "I would consider purchasing the Yantai (Rushan) apple." (b) "I am interested in buying the Yantai (Rushan) apple." and (c) "I am likely going to purchase the Yantai (Rushan) apple" [1 = strongly disagree to 7 = strongly agree; adapted from Steinhart et al. (2014), Belanche et al. (2021); $\alpha$ = 0.868]. In addition, participants answered questions about product familiarity and regional image. Considering the potential impact of these two variables on purchase intention, they were included as control variables in the model. Finally, participants answered basic demographic information.

### 3.2.2 Results

#### 3.2.2.1 Manipulation check

The results of the paired sample *t*-test showed that participants had a higher abstract perception of advertising in the abstract appeal condition [$M_{abstract} = 5.048$, $SD = 1.354$; $M_{concrete} = 4.183$, $SD = 1.671$; $t_{(103)} = 3.409$, $p < 0.001$]. In addition, participants had a higher concrete perception of advertising in the concrete appeal condition [$M_{abstract} = 3.126$, $SD = 1.557$; $M_{concrete} = 5.553$, $SD = 1.007$; $t_{(102)} = 10.616$, $p < 0.001$].

#### 3.2.2.2 Purchase intention

We subjected the data to a two-way ANOVA with purchase intention as the dependent variable and gender, age, educational background, individual monthly consumption, buying the product or not, product familiarity, and regional image as the control variables. The results revealed a significant interaction between regional typicality and advertising appeal types [$F_{(1,196)} = 22.254$, $p < 0.001$], supporting Hypothesis 1. In line with Hypothesis 1a, abstract appeal led to significantly more favorable consumers' purchase intention than concrete appeal for high regional typicality [$M_{abstract} = 5.701$, $SD = 0.643$; $M_{concrete} = 5.206$, $SD = 1.008$; $F_{(1,196)} = 11.605$, $p < 0.001$). Consistent with Hypothesis 1b, concrete appeal led to significantly more favorable consumers' purchase intention than abstract appeals for low regional typicality [$M_{abstract} = 5.180$, $SD = 1.168$; $M_{concrete} = 5.670$, $SD = 0.748$; $F_{(1,196)} = 11.400$, $p < 0.001$]. See Figure 1.

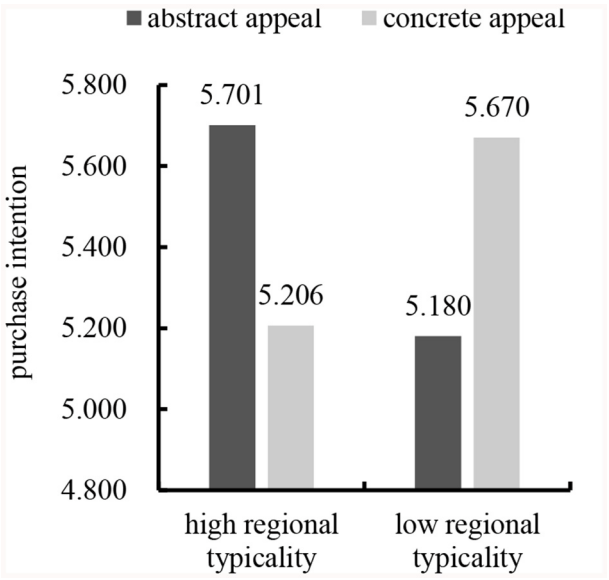


FIGURE 1
Interaction effect of regional typicality and advertising appeal types on purchase intention.

### 3.2.3 Discussion

Study 1 selected "Yantai apple" and "Rushan apple" as stimulus products of high and low regional typicality, respectively, and adopted different advertising appeal types (abstract vs. concrete) to trigger different consumers' purchasing intention. Specifically, abstract (vs. concrete) appeal could improve consumers' purchase intention for geographical indication products with high regional typicality. On the contrary, concrete (vs. abstract) appeal could improve consumers' purchase intention for geographical indication products with low regional typicality. These results supported Hypotheses 1, 1a, and 1b.

Although improving consumers' purchase intention could increase the brand value of geographical indication products to a certain extent, a more important issue was an increase in the value perception of geographical indication products (represented by consumers' willingness to pay a price premium). Consumers' willingness to pay higher prices for high-quality products would contribute to the further realization of geographical indication brand value. Therefore, we used willingness to pay a price premium as the dependent variable to test the hypotheses in the next study.

## 3.3 Study 2

Study 2 aimed to replicate the result of Study 1 and tested the underlying mechanism of the effect with three major changes. First, this study considered the processed agricultural product (tea) as the stimulus product to replace the primary agricultural product (apple) in Study 1. Second, this study used consumers' willingness to pay a price premium as a dependent variable. Third, this study directly tested the proposed processing fluency mechanism that underlies the observed effect.

### 3.3.1 Method

#### 3.3.1.1 Participants

A total of 252 Wjx.com participants were recruited and randomly assigned to one of four conditions in a 2 (regional typicality: high vs. low) ×2 (advertising appeal: abstract vs. concrete) between-subjects design. Then, we excluded 24 participants who failed the attention check, leaving 228 responses (100 female participants; $M_{age} = 26.92$) for subsequent analyses.

#### 3.3.1.2 Procedure

This study used variations of "tea" as stimulus products, among which "West Lake Longjing tea" and "Rongcheng green tea" were the products of high and low regional typicality, respectively.

First, participants were shown the advertising appeal of the product. The manipulation of advertising appeal was similar to Study 1. Then, participants were asked to answer the same manipulation check questions about abstract and concrete appeals as in Study 1. Participants were asked to answer the following three-item question about willingness to pay a price premium for the product subsequently: (a) "I am willing to pay a higher price for West Lake Longjing tea (Rongcheng green tea) than for similar products." (b) "I am willing to pay a lot more for West Lake Longjing tea (Rongcheng green tea) than similar products." and (c) "I am willing to buy West Lake Longjing tea (Rongcheng green tea) even if the price of similar products is a little lower" [1 = strongly disagree to 7 = strongly agree; adapted from Netemeyer et al. (2004), Dwivedi et al. (2018); $\alpha = 0.908$]. In addition, participants were asked to answer another three-item question about processing fluency: (a) "The advertising is easy to understand for me." (b) "The advertising is easy to process for me." and (c) "I think the message of the advertising is clear and flowing" [1 = strongly disagree to 7 = strongly agree; adapted from Lee and Aaker (2004), White et al. (2011); $\alpha = 0.729$]. Finally, participants answered basic demographic information.

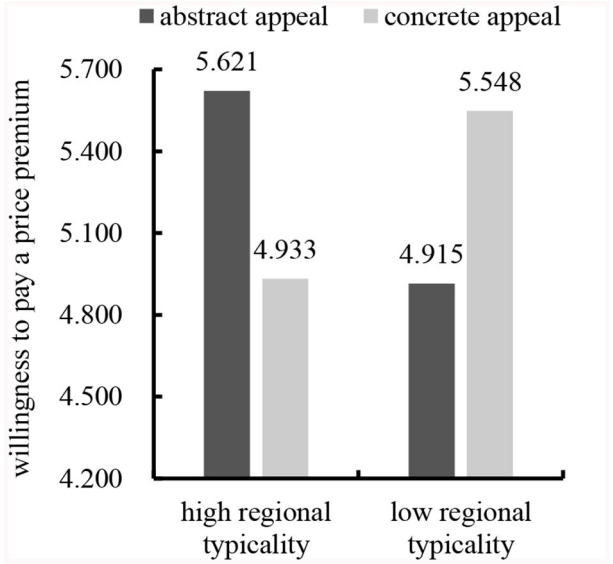


FIGURE 2
Interaction effect of regional typicality and advertising appeal types on willingness to pay a price premium.

### 3.3.2 Results

#### 3.3.2.1 Manipulation check

The results of the paired sample t-test showed that participants had a higher abstract perception of advertising in the abstract appeal condition [$M_{abstract} = 5.027$, $SD = 1.473$; $M_{concrete} = 4.354$, $SD = 1.658$; $t_{(112)} = 2.970$, $p = 0.004$]; In addition, participants had a higher concrete perception of advertising in the concrete appeal condition [$M_{abstract} = 3.313$, $SD = 1.813$; $M_{concrete} = 5.522$, $SD = 1.172$; $t_{(114)} = 9.192$, $p < 0.001$].

#### 3.3.2.2 Willingness to pay a price premium

We subjected the data to a two-way ANOVA with willingness to pay a price premium as the dependent variable and gender, age, educational background, individual monthly consumption, and buying the product or not as the control variables. The results revealed a significant interaction between regional typicality and advertising appeal types [$F_{(1,219)} = 18.785$, $p < 0.001$], supporting Hypothesis 1 again. In line with Hypothesis 1a, abstract appeal led to significantly more favorable consumers' willingness to pay a price premium than concrete appeal for high regional typicality [$M_{abstract} = 5.621$, $SD = 0.980$; $M_{concrete} = 4.933$, $SD = 1.408$; $F_{(1,219)} = 10.224$, $p = 0.002$]. In line with Hypothesis 1b, concrete appeal led to significantly more favorable consumers' willingness to pay a price premium than abstract appeals for low regional typicality [$M_{abstract} = 4.915$, $SD = 1.418$; $M_{concrete} = 5.548$, $SD = 1.046$; $F_{(1,219)} = 7.813$, $p = 0.006$]. See Figure 2.

#### 3.3.2.3 Mediation effect analyses

To test the mediating effect, this study conducted a moderated mediation analysis with processing fluency entered as the mediator (model 8, bootstrapping sample size = 5,000; Preacher and Hayes, 2008). In this analysis, the dependent variable was willingness to pay a price premium, and the control variables were gender, age, educational background, individual monthly consumption, and buying the product or not. The results supported the predictions (see Figure 3). Processing fluency ($\beta = 0.889$, $SE = 0.219$, $t = 4.054$, $p < 0.001$) was predicted by the interaction between regional typicality and advertising appeal types in the mediator model. In the dependent variable model, processing fluency ($\beta = 0.632$, $SE = 0.084$, $t = 7.546$, $p < 0.001$) predicted consumers' willingness to pay a price premium. Meanwhile, the interaction between regional typicality and advertising appeal types was significant ($\beta = 0.758$, $SE = 0.282$, $t = 2.690$, $p = 0.008$). Furthermore, the conditional indirect effect of processing fluency was significant in the high regional typicality condition ($\beta = 0.253$; 95% $CI$ [0.061, 0.461]) and the low regional typicality condition ($\beta = -0.309$; 95% $CI$ [-0.560,−0.094]). These results supported Hypothesis 3.

### 3.3.3 Discussion

Study 2 selected "West Lake Longjing tea" and "Rongcheng green tea" as stimulus products of high and low regional typicality, respectively, and adopted different advertising appeal types (abstract vs. concrete) to trigger the mediating mechanism and thus generate consumers' willingness to pay a price premium. Specifically, for geographical indication products of high (low) regional typicality, abstract (concrete) appeal could trigger consumers' higher processing fluency and thus increase their willingness to pay a price premium. These results supported Hypothesis 2. At the same time, the results of Study 1 were replicated.

This study supported that the matching of regional typicality and advertising appeal types would increase consumers' purchase intention and willingness to pay a price premium in studies 1 and

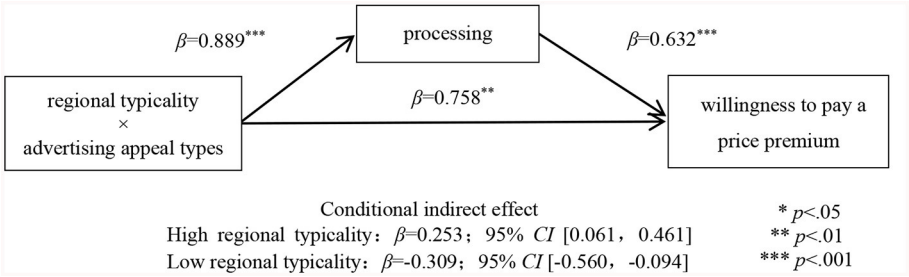


FIGURE 3
Mediating effect of processing fluency.

2, respectively. However, the realization of geographical indication brand value also needed word-of-mouth publicity from consumers. Therefore, we used recommendation intention as the dependent variable to further test the hypotheses in the next study.

## 3.4 Study 3

Study 3 aimed to test the proposed moderating effect of spatial distance with three major changes. First, this study changed the stimulus products again by selecting oysters. Second, it used consumers' recommendation intention as a dependent variable. Finally, it added spatial distance to the model to verify the moderating effect. This study predicted that abstract (concrete) appeal could improve consumers' recommendation intention for geographical indication products of high (low) regional typicality in the distant (close) spatial distance condition.

### 3.4.1 Method

#### 3.4.1.1 Participants

A total of 448 Wjx.com participants were recruited and assigned to one of eight conditions in a 2 (regional typicality: high vs. low) ×2 (advertising appeal: abstract vs. concrete) ×2 (spatial distance: distant vs. close) between-subjects design. Then, we excluded 44 participants who failed the attention check, leaving 404 responses (188 female participants; $M_{age} = 26.44$) for subsequent analyses.

#### 3.4.1.2 Procedure

This study used variations of "oyster" as stimulus products, among which "Rushan oyster" and "Zhuanghe oyster" were the products of high and low regional typicality, respectively. According to the existing research, we regard the consumers whose current residence is in the same province as the consumers with close spatial distance and the consumers whose current residence is in other provinces as the consumers with distant spatial distance. We aimed to manipulate spatial distance by recruiting participants at designated locations in this study. For example, for the high regional typicality—abstract appeal group, approximately half of the participants we recruited were from Shandong Province (close spatial distance), and half were from other provinces (distant spatial distance).

First, participants were asked to fill in their current residence. Next, they were shown the advertising appeal of the product. The manipulation of advertising appeal was similar to Study 1. Then, they were asked to answer the same manipulation check questions about abstract and concrete appeals as in Study 1. Participants were asked to answer the same three-item question about processing fluency as in Study 2 subsequently. In addition, they were asked to answer another three-item question about recommendation intention toward the product: (a) "I would recommend the Rushan (Zhuanghe) oyster to my relatives and friends." (b) "I would share the information about the Rushan (Zhuanghe) oyster with relatives and friends." and (c) "I would encourage relatives and friends to buy the Rushan (Zhuanghe) oyster" [1 = strongly disagree to 7 = strongly agree; adapted from Bigne et al. (2001), Belanche et al. (2021); $\alpha = 0.810$]. Finally, participants answered basic demographic information.

### 3.4.2 Results

#### 3.4.2.1 Manipulation check

The results of paired sample *t*-test showed that participants had a higher abstract perception of advertising in the abstract appeal condition [$M_{abstract} = 5.207$, $SD = 1.505$; $M_{concrete} = 4.443$, $SD = 1.692$; $t_{(202)} = 4.226$, $p < 0.001$]. In addition, participants had a higher concrete perception of advertising in the concrete appeal condition [$M_{abstract} = 3.915$, $SD = 1.783$; $M_{concrete} = 5.428$, $SD = 1.152$; $t_{(200)} = 8.872$, $p < 0.001$].

#### 3.4.2.2 Recommendation intention

We subjected the data to a two-way ANOVA with recommendation intention as the dependent variable and gender, age, educational background, individual monthly consumption, and buying the product or not as the control variables. The results revealed a significant interaction between regional typicality and advertising appeal types [$F_{(1,395)} = 20.347$, $p < 0.001$], supporting Hypothesis 1 again. In line with Hypothesis 1a, abstract appeal led to significantly more favorable consumers' recommendation intention than concrete appeal for high regional typicality [$M_{abstract} = 5.726$, $SD = 0.824$; $M_{concrete} = 5.231$, $SD = 1.145$; $F_{(1,395)} = 14.924$, $p < 0.001$]. Consistent with Hypothesis 1b, concrete appeal led to significantly more favorable consumers' recommendation intention than abstract appeals for low regional typicality [$M_{abstract}$

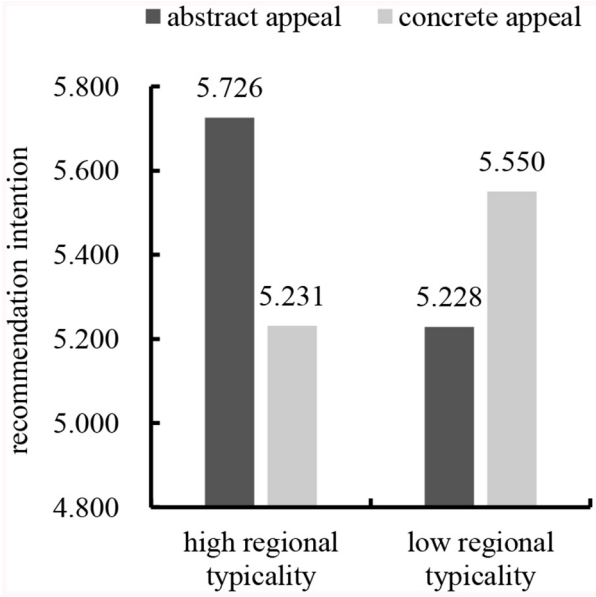


FIGURE 4
Interaction effect of regional typicality and advertising appeal types on recommendation intention.

$= 5.228$, $SD = 0.904$; $M_{concrete} = 5.550$, $SD = 0.923$; $F_{(1,395)} = 6.369$, $p = 0.012$]. See Figure 4.

#### 3.4.2.3 Mediation effect analyses

To test the mediating effect, this study conducted a moderated mediation analysis with processing fluency entered as the mediator (model 8, bootstrapping sample size = 5,000; Preacher and Hayes, 2008). In this analysis, the dependent variable was recommendation intention, and the control variables were gender, age, educational background, individual monthly consumption, and buying the product or not. The results supported the predictions (see Figure 5). Processing fluency ($\beta = 0.758$, $SE = 0.140$, $t = 5.425$, $p < 0.001$) was predicted by the interaction between regional typicality and advertising appeal types in the mediator model. In the dependent variable model, processing fluency ($\beta = 0.435$, $SE = 0.062$, $t = 7.060$, $p < 0.001$) predicted consumers' recommendation intention. Meanwhile, the interaction between regional typicality and advertising appeal types was significant ($\beta = 0.488$, $SE = 0.177$, $t = 2.754$, $p = 0.006$). Furthermore, the conditional indirect effect of processing fluency was significant in the high regional typicality condition ($\beta = 0.150$; 95% $CI$ [0.054, 0.260]) and the low regional typicality condition ($\beta = -0.179$; 95% $CI$ [−0.291, −0.089]), supporting Hypothesis 2 again.

#### 3.4.2.4 Moderation effect analyses

This study conducted an ANOVA with recommendation intention as the dependent variable and gender, age, educational background, individual monthly consumption, and buying the product or not as the control variables. The results revealed a marginal significant interaction among regional typicality, advertising appeal types, and spatial distance on recommendation intention [$F_{(1,391)} = 3.016$, $p = 0.083$], supporting Hypothesis 3.

In this study, group analysis facilitated interpretation. The results showed a significant interaction between regional typicality and advertising appeal types on recommendation intention in the distant spatial distance condition [$F_{(1,193)} = 20.525$, $p < 0.001$]. Further simple effect analysis showed that abstract appeal led to significantly more favorable consumers' recommendation intention than concrete appeal for high regional typicality [$M_{abstract} = 6.041$, $SD = 0.798$; $M_{concrete} = 5.157$, $SD = 1.109$; $F_{(1,193)} = 25.439$, $p < 0.001$). However, the results revealed no significant difference between abstract appeal and concrete appeal on consumers' recommendation intention for low regional typicality [$M_{abstract} = 4.975$, $SD = 0.798$; $M_{concrete} = 5.244$, $SD = 1.054$; $F_{(1,193)} = 2.218$, $p = 0.138$; see Figure 6]. These results supported Hypothesis 3a.

In addition, the results showed a significant interaction between regional typicality and advertising appeal types on recommendation intention in the close spatial distance condition [$F_{(1,193)} = 4.405$, $p = 0.037$]. Further simple effect analysis showed that concrete appeal led to significantly more favorable consumers' recommendation intention than abstract appeal for low regional typicality [$M_{abstract} = 5.451$, $SD = 0.996$; $M_{concrete} = 5.839$, $SD = 0.627$; $F_{(1,193)} = 4.847$, $p = 0.029$]. However, the results revealed no significant difference between abstract appeal and concrete appeal on consumers' recommendation intention for high regional typicality [$M_{abstract} = 5.441$, $SD = 0.811$; $M_{concrete} = 5.288$, $SD = 1.188$; $F_{(1,193)} = 0.706$, $p = 0.402$; see Figure 7]. These results supported Hypothesis 3b.

### 3.4.3 Discussion

Study 3 selected "Rushan oyster" and "Zhuanghe oyster" as stimulus products of high and low regional typicality, respectively, and adopted abstract and concrete appeals to trigger consumers' recommendation intention in different spatial distances. Specifically, this study promoted the effect of high regional typicality and abstract appeal on consumers' recommendation intention in the distant spatial distance condition and the effect of low regional typicality and concrete appeal on consumers' recommendation intention in the close spatial distance condition. The results supported Hypotheses 3, 3a, and 3b.

## 4 General discussion

The region of origin is crucial for geographical indication products. Existing research has focused on the geographical indication products themselves, neglecting the close association between geographical indication products and their region of origin, namely, regional typicality. In fact, consumers have different attitudes and preferences toward geographical indication products with different regional typicality. Particularly for geographical indication products with low regional typicality, most consumers are not familiar with them, which fails to stimulate their positive attitudes and willingness to purchase. Therefore, this research explores how to cultivate individuals' positive attitudes and consumption intentions for geographical indication products with different regional typicality using corresponding advertising appeals from the perspective of regional typicality. Specifically, this research examines the interaction effect, mediating mechanism,

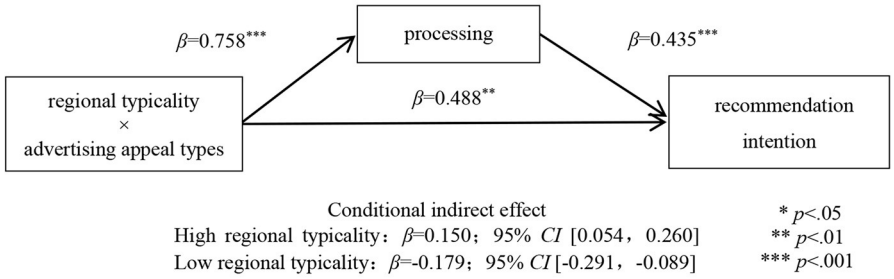


FIGURE 5
Mediating effect of processing fluency.

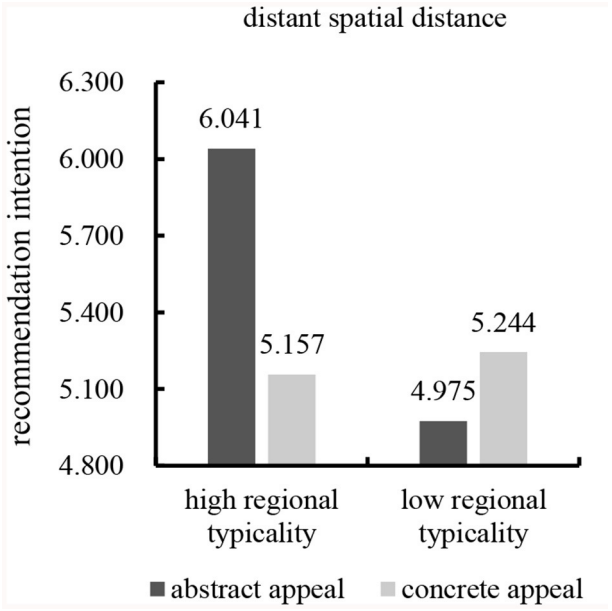


FIGURE 6
Effect of distant spatial distance on interaction.

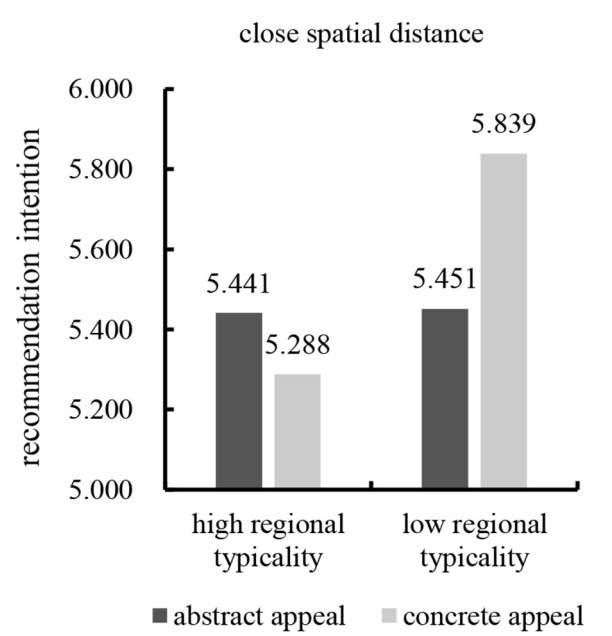


FIGURE 7
Effect of close spatial distance on interaction.

and boundary conditions of regional typicality and advertising appeal types on consumption intention toward geographical indication products through three studies. The results show that adopting abstract appeal can improve the consumers' purchasing intention when the regional typicality of geographical indication products is high. Conversely, adopting concrete appeal can improve the consumers' purchasing intention if the regional typicality is low in geographical indication products (Study 1). At the same time, processing fluency plays a mediating role in the interaction between regional typicality (high vs. low) and advertising appeal types (abstract vs. concrete) on consumers' willingness to pay a price premium (Study 2). In addition, adopting the abstract appeal in high regional typicality condition can improve consumers' recommendation intention more when spatial distance is distant. Conversely, when spatial distance is close, adopting the concrete appeal in low regional typicality conditions can improve consumers' recommendation intention more (Study 3). The findings of this research develop the literature on consumer behavior toward geographical indications and provide practical implications for the marketing of geographical indication products.

## 4.1 Theoretical contributions

This research contributes to the literature in several ways. First, it enriches the literature on typicality. Previous studies mainly focused on the typicality of products. For example, typical products are more attractive and could increase consumers' purchase intention (Scarpi et al., 2019), and disease cues affect consumers' preference for typical (vs. atypical) products (Huang and Sengupta, 2020). However, this research concentrates on the typicality of origin to explore how to enhance the consumption intention

toward geographical indication products with different regional typicality, which provides a supplement to the typicality literature.

Second, we contribute to the research on consumer behavior of geographical indication products by identifying "regional typicality" as a new research perspective. The literature on the consumer behavior of geographical indication products mostly studies from a product perspective (Loureiro and Umberger, 2007; Zhang et al., 2022), and rarely involves the region of origin perspective. Based on consumers' association with products and region of origin, this research tries to adopt advertising appeal to explore consumption intention toward geographical indication products with different regional typicality. This investigation paves the way for future studies to conduct a further in-depth analysis of consumer behavior of geographical indication products from the perspective of "regional typicality."

Third, the findings of this research add to our understanding of abstract appeal and concrete appeal (Gottlieb et al., 1977; Schwanenflugel and Shoben, 1983; Fong and Nisbett, 1991). Previous studies investigate the impact of abstract and concrete appeals on consumer behavior mostly via analyzing their relative effectiveness in different situations from the perspective of temporal distance (distant vs. imminent) (Kim et al., 2009) and individual characteristics (independent self-view vs. interdependent self-view) (Ku, 2021). This research introduces a new contextual variable, "regional typicality," to explore the effect changes of abstract and concrete appeals under different regional typicality (high vs. low). This not only enriches and improves the research on the matching effect of abstract and concrete advertising appeals in the field of marketing, especially in the field of consumer behavior, but also contributes to the literature on advertising appeals in the consumer behavior of geographical indication products.

Finally, this research finds and tests the mediating effect of processing fluency on the interaction between regional typicality (high vs. low) and advertising appeal types (abstract vs. specific). Therefore, it provides a complete causal chain model for the study of consumer behavior of geographical indication product from the perspective of "regional typicality." Moreover, this exploration deepens the role of processing fluency in consumers' cognition of advertising appeal and expands the related research on processing fluency (Lee and Labroo, 2004; White et al., 2011; Kidwell et al., 2013).

## 4.2 Practical implications

This article provides important implications for the marketing of geographical indication products and the promotion of brand value. First, for geographical indication products, the product is closely related to its region of origin. In reality, most advertisements focus on the promotion of product features and ignore the features of the region of origin. Therefore, marketers should focus on advertising features of the region of origin. In addition, marketers should pay attention to distinguishing the regional typicality of geographical indication products and implement accurate advertising strategies for products of different regional typicality. Specifically, they should adopt abstract appeal for geographical indication products with high regional typicality. In other words, marketers should use vague and subjective descriptions to highlight the holistic evaluation of the region of origin. On the contrary, marketers should adopt concrete appeal for geographical indication products with low regional typicality, that is, they should use a specific and objective way to describe the details of the region of origin. In this way, consumers could experience higher processing fluency and enhance their consumption intention toward geographical indication products.

Second, marketers should pay attention to the spatial distance between consumers and the region of origin of geographical indication products so as to strengthen the matching effect between regional typicality and advertising appeal types. When the spatial distance is distant, the effect of adopting abstract appeal is more prominent for geographical indication products with high regional typicality. On the contrary, when the spatial distance is close, the effect of adopting concrete appeal is more obvious for geographical indication products with low regional typicality. For example, if the geographical indication products with high regional typicality want to exploit non-local market, marketers should adopt abstract appeal because the spatial distance is distant between consumers and region of origin in this case. In short, marketers should only achieve the mutual fit of the three in order to maximize the promotion of geographical indication brand value.

Finally, local governments should help the market expansion and brand building of geographical indication products, especially geographical indication products with low regional typicality, through various ways. For example, local governments should contribute to the publicity and promotion of geographical indication products with low regional typicality by holding various agricultural product fairs and promotion meetings. In addition, they should develop agricultural product regional public brands and publicity platforms to integrate individual geographical indication brands. This integration enhances the radiation and driving role of geographical indication products with high regional typicality. Only this strategy could promote the brand value of geographical indication and realize the balanced development of the geographical indication industry.

## 4.3 Limitations and future research

Although our research has obtained some meaningful conclusions, it has some limitations needing further investigation. First, the data from our three studies were obtained through online experiments, and the participants were mainly young. Future research should test the interaction, mediating mechanism, and boundary conditions between regional typicality and advertising appeal types through field experiments or real transaction data to further improve the robustness of the findings of this research.

Secondly, the three studies all used text information to manipulate abstract and concrete appeals, while pictures are also an important part of advertising campaigns. Future research could change the manipulation way of advertising appeal to explore the interaction between advertising appeal and regional typicality on consumption intention toward products, for example, by using advertising images to show the features of the region of origin (Zhou et al., 2021; Loebnitz and Grunert, 2022).

Moreover, this research used spatial distance as a moderating variable to explore the boundary of the interaction between regional typicality and advertising appeal types. Future research could further explore other boundary conditions that influence the interaction effect, such as social distance between consumers and geographical indication products, and cognitive style of consumers (analytic thinking vs. holistic thinking).

Finally, all three studies considered agricultural products as research objects since most geographical indication products are agricultural products in China. Future research could examine whether these findings apply to non-agricultural geographical indication products such as handicrafts. Therefore, future research could extend our research objects to non-agricultural geographical indication products to enhance the general applications of these findings.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by the Science Ethics Committee of Huazhong Agricultural University (ID number: HZAUHU-2022-0026). The studies were conducted in accordance with the local legislation and institutional requirements. The ethics committee/institutional review board waived the requirement of written informed consent for participation from the participants or the participants' legal guardians/next of kin because all procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or research committee, and the personal privacy of the participants was protected.

## Author contributions

DW: Conceptualization, Methodology, Writing – original draft. YX: Data curation, Formal analysis, Writing – review & editing. WL: Funding acquisition, Writing – review & editing. YL: Supervision, Writing – review & editing.

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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# Uncovering the potential of evaluative conditioning in shaping attitudes toward sustainable product packaging

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**Introduction:** The necessity to promote pro-environmental behavior change in individuals and society is increasingly evident. This study aimed to investigate the effect of evaluative conditioning on consumers' perception of product packaging.

**Methods:** We first produced two stimulus sets: one including images of supermarket products with different packaging and the other containing affective images of healthy nature (positive) and climate change impact (negative). These images were then paired in an evaluative conditioning experiment where respondents were informed about the impact of product packaging.

**Results:** We found an effect of conditioning depending on the initial sustainability perception that participants had toward product packaging. Pairing products for which participants were uncertain about their sustainability with negative or positive affective images had a significant effect on the sustainable associations of the consumers in a negative or positive direction, respectively. However, the impact of conditioning on products that clearly had (un)sustainable packaging was not that strong.

**Discussion:** These results provide new tools and evidence to further investigate the power of evaluative conditioning in pro-environmental attitude and behavior change.

KEYWORDS

**evaluative conditioning, affective images, sustainability, attitude change, implicit associations**

## 1 Introduction

The behavior of people on a daily basis has an effect on their own health and well-being, but also on the health and well-being of other individuals, groups, and on society at large, which thereby causes and alleviates social problems such as climate change (Fishbein and Ajzen, 2010). The effects of human behavior on the environment have been unequivocally established by the Intergovernmental Panel on Climate Change; humans have warmed the atmosphere, oceans and land. Widespread and rapid changes in the atmosphere, ocean cryosphere, and biosphere have occurred (SPM, p. 5). Amongst other factors, pollution from fossil-based plastic waste and other waste related to packaging have a devastating effect on the quality of air, soil, and water, which accelerates climate change (Borrelle et al., 2020; Boz et al., 2020; Phelan et al., 2022).

Although the majority of people say they prefer sustainable and waste-free products (Rokka and Uusitalo, 2008), they do not always purchase them (Jerzyk, 2016) and thus excessive consumption patterns still exist (Stolz et al., 2013). This discrepancy between what people say and what they do is labeled as the attitude-behavior gap (Kennedy et al., 2009). This problem is often encountered when investigating ethical, social, or responsible consumer behavior. Even for people who intend to act sustainably, survey studies showed that they could not correctly describe an ecological-friendly packaging or did not have a clear idea of what it looked like (Lindh et al., 2016a,b).

Recently, Leeuwis et al. (2022b) proposed a framework for the design of behavior change interventions that could promote pro-environmental attitude and behavior among consumers. In their review, they pointed out that behavior change interventions could possibly rely on visualizations of climate change impact, since these have been shown to induce emotional response (O'Neill and Nicholson-Cole, 2009; Lehman et al., 2019; Dal Fabbro et al., 2021) and engagement (O'Neill, 2020) in viewers. Using climate change visualization, interventions can be designed to draw attention to sustainable products (Van der Laan et al., 2017; Ischen et al., 2022) or condition consumers toward more positive emotions and reward associations in response to green products (Leeuwis et al., 2022b). This method, which is known as evaluative conditioning (also affective or emotional conditioning), has been identified as a potential method that could change consumers' behavior toward more sustainable purchase decisions and therefore bridge their attitude-behavior gap.

Evaluative Conditioning (EC) is a form of associative learning that can be used for changing preferences by creating a relation between actions and emotional responses (Eder et al., 2019; De Houwer and Hughes, 2020). EC has been successfully implemented in several studies for behavior change in the health domain, although the results on the lasting effects of the intervention have not been fully conclusive (Houben et al., 2010; Hollands et al., 2011; Hollands and Marteau, 2016; Papies, 2017; Moran et al., 2023). Successful examples include pairing healthy food with images carrying positive affect (Halbeisen and Walther, 2021) or unhealthy food with aversive images (Hollands et al., 2011), after which the preferences for products changed and participants were more likely to pick a piece of fruit instead of the snack they would have chosen before the conditioning. EC has also been used to promote pro-vaccination attitudes: aversive cues (e.g., images showing sickness or death) in ads promoting flu vaccine products could enhance attitudes towards a co-occurring vaccine brand, but only when people were under a low attentional load (Fan et al., 2021).

Especially following the latter example, ethical concerns regarding EC are raised whether the presentation of affective imagery impairs the autonomy with which individuals make their choices (Biegler and Vargas, 2016). EC is very common in the real world where commercial products are paired with affective images to improve brand attitude, which follows from studies on EC with consumer products (Pleyers et al., 2007; Sweldens et al., 2010). Usually, EC in advertising is aimed at promoting brand attitudes, however, companies might be tempted to use it as a technique for greenwashing; an activity in which a product is advertised to have more sustainability qualities than it actually does (Walker and Wan, 2012). This activity of greenwashing calls for a deeper understanding of the conditions that cause EC effects to take hold, both to promote sustainable products and intervene against unsubstantiated claims in favor of non-sustainable alternatives (Fernandes et al., 2020). In the line of conditioning for ethical decisions, EC has been applied to combat positive attitudes towards alcohol consumption: after the intervention, participants showed more negative attitudes toward beer, experienced less craving, and consumed less both in the lab during the taste test and outside the lab during the week following the session (Houben et al., 2010).

In the context of environmental research, studies have shown that conditioning could be an interesting intervention to explore. EC using images of cheerful animals motivated participants to perform more pro-environmental efforts, although only in half of the studies (Lange and Dewitte, 2023). Moreover, images of nature could motivate pro-environmental behavior (Yu et al., 2023) and might inform the consumer about the sustainability of products in the supermarket. For example, Meijers et al. (2021) presented images or texts concerning natural scenes when people grabbed a product in a virtual reality (VR) supermarket. This affected their attitudes as well as self-reported buying behavior toward more pro-environmental choices up to 2 weeks after the intervention. To date, there have been very few investigations into the relationship of consumers with sustainable packaging and the effect of pro-environmental interventions. This is mainly due to the lack of established datasets of images, both for the stimuli that the behavior change intervention acts on (i.e., the products) and the affective images that would be shown during the intervention (i.e., climate change visualization).

We here aimed to investigate the effect of evaluative conditioning on pro-environmental attitude in two steps. First, we collected and validated two stimulus sets including (1) images of supermarket products that were rated based on the sustainability of their packaging, and (2) images of nature and climate change impact that were rated based on their relevance to climate change, as well as the arousal and valence they evoked in the participants. These two image datasets together with their ratings are shared in the Supplementary material with the aim to promote collaboration and future research within this domain. Secondly, we used the collected stimulus sets to investigate the effect of evaluative conditioning on consumers' perception of product packaging. Therefore, the work presented in this paper is divided in two parts, each consisting of two studies; In Study 1 and 2, the creation of the two stimulus sets (supermarket products and climate-related images) and the surveys pertaining to their validation are reported. In the subsequent Study 3 and 4, we present the outcome of evaluative conditioning attempts using these stimulus sets. In Study 3, we used the climate-related affective images from Study 2 to condition participants toward product packaging that, based on the ratings of Study 1, was rated on the extremes of sustainability scale (i.e., clearly sustainable or unsustainable). In Study 4, we repeated this conditioning for product packaging that was rated in the middle of the scale (i.e., their sustainability was ambiguous to the participants). An overview of the studies is presented in Figure 1.

## 2 Creation of stimulus sets

The creation of validated stimulus sets for a conditioning paradigm was conducted in two studies. In the first study, images of products in a supermarket were collected and participants rated their sustainability on a 7-point Likert scale. In the second study, images of nature and climate change were rated on a 9-point Likert scale of relevance, arousal, and valence. Their methods and results will be discussed separately.

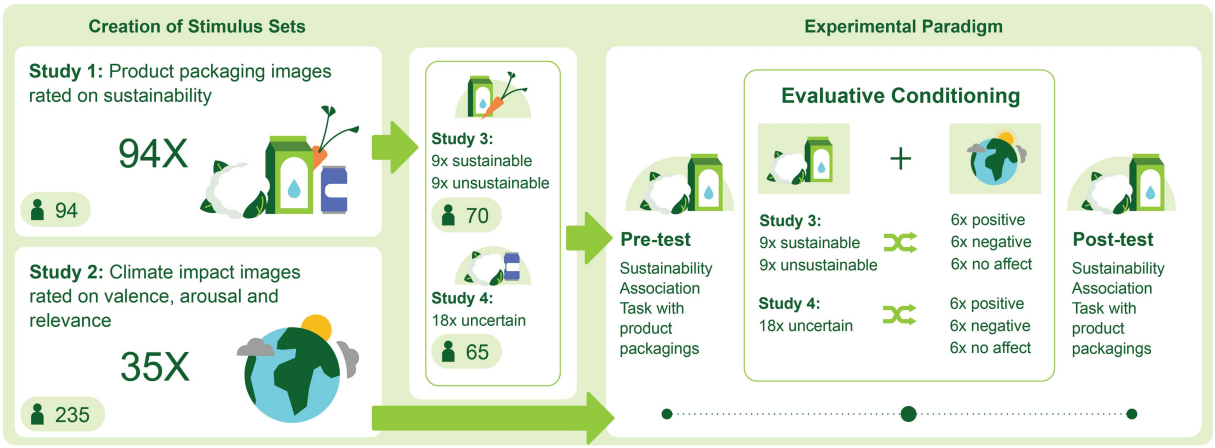


FIGURE 1
An overview of the studies presented in the manuscript. Two stimulus sets were created in Study 1 and 2, which were applied in an evaluative conditioning paradigm in Study 3 and 4. Study 1 collected sustainability ratings of supermarket product images in terms of packaging, and Study 2 collected valence ratings of nature and climate change-related images. Consequently, the nature image pairs that were most strongly divided in valence were coupled to the product packaging images as evaluative conditioning. In Study 3, product images with the highest and lowest ratings of packaging sustainability were paired with either positive, neutral, or negatively-valenced climate images. In Study 4, the same climate impact images were applied in the conditioning paradigm but this time they were paired with product images whose packaging was rated in the middle of the sustainability spectrum, i.e., participants were uncertain about their sustainability.

## 2.1 Study 1: Product images

### 2.1.1 Methods

#### 2.1.1.1 Stimuli

Images were selected based on their appearance on a grocery retailer website[1] and websites with open creative licenses such as Pexels.com. They were selected based on their packaging; they either contained no packaging, re-usable/recyclable packaging, or packaging that claimed to be better for the climate or packaging in excessive plastic. The images from the websites were modulated such that their background was white and the logos on all packages were made unrecognizable. In total, 94 images were included in the test, which can be found in the Supplementary material A.

#### 2.1.1.2 Participants

A total of 94 participants (21 Male, 73 Female; $M_{age}$ = 21.16, $SD_{age}$ = 2.92) were recruited using the university subject pool. They received course credit in return for their participation in the experiment. The study was approved by the Research Ethics Committee of Tilburg School of Humanities and Digital Sciences (TSHD_RP123a). Prior to the experiment, participants read an information letter and signed an informed consent form. Of these respondents, 26 were not responsible for the grocery shopping themselves (37.7% of the females, 40% of the males). The number of respondents was determined following the pilot study ($n$ = 68) of Koenig-Lewis et al. (2022), where products were rated on a Likert scale to determine their perceived healthiness, and then oversampled.

#### 2.1.1.3 Questionnaires

Three questionnaires were collected prior to the task; demographics, New Environmental Paradigm, and Health Consciousness. The demographical questions assessed the gender and age of the participants as well as their responsibility for grocery shopping at least for the majority of their meals. The New Environmental Paradigm (NEP; Dunlap et al., 2000) is a 15-item questionnaire that assesses environmental beliefs and is answered on a 5-point Likert scale. The odd questions of the NEP are worded in line with pro-ecological view and hence are reversed when calculating the average score for each participant. Health Consciousness (HC) was measured by 4 items on a 7-point Likert scale following Mai and Hoffmann (2015). Health is considered important for grocery purchase decisions (Koenig-Lewis et al., 2022).

#### 2.1.1.4 Procedure

The survey was administered using Qualtrics. Participants read the information letter and were only able to continue when they provided informed consent. First, participants answered demographical questions and the NEP and HC questions. After that, they were introduced to the task. The task was to judge the product images on (un)sustainability on a 7-point Likert scale (Figure 2). Sustainability in this case was defined: "in the sense of packages owning attributes aiming at reducing the product's environmental footprint. Think of the materials of the package, recyclability and ecological footprint." The questions were repeated twice for each product; participants rated each product on both 'sustainability' and 'unsustainability' terms. Moreover, the scales were randomized between subjects: half of participants rated on a scale where *Very sustainable* was presented on the left and *Very unsustainable* on the right, whereas for the other half it was the other way around. These design choices were implemented to overcome positivity bias and any biases from left/right associations (Weijters et al., 2013). Participants rated 94 products in random order in two blocks (a total of 188 trials).

1 https://www.ah.nl/producten

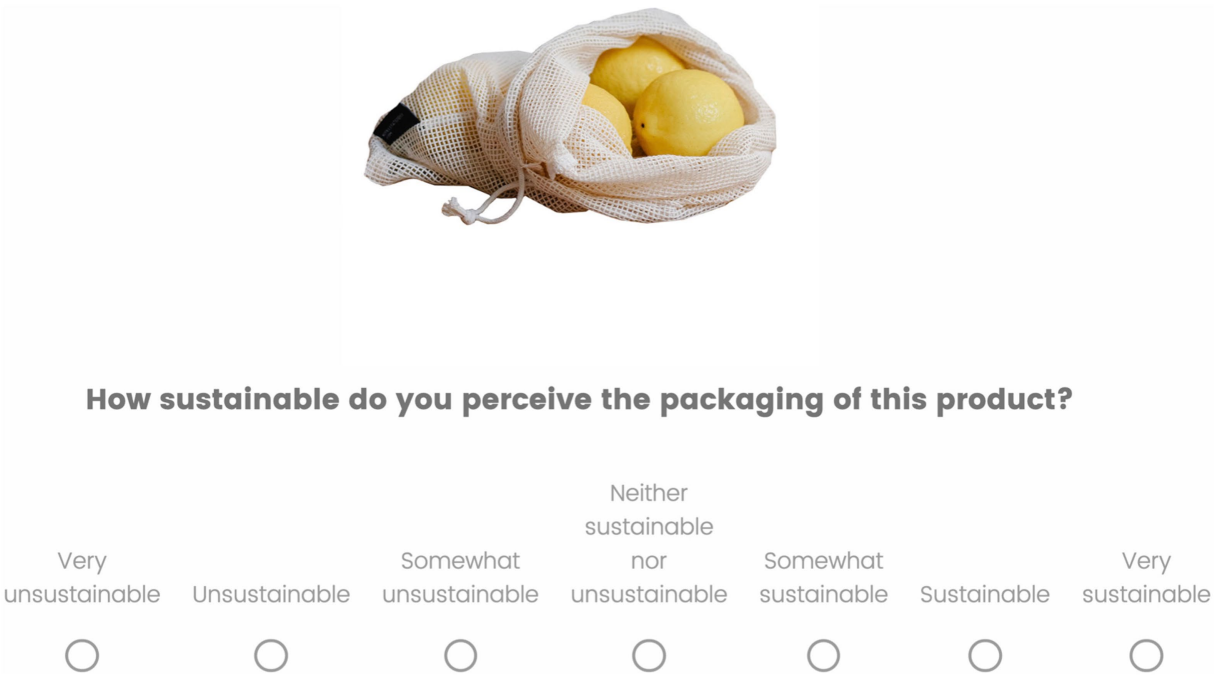


FIGURE 2
The rating task where participants rated the sustainability of the packaging of the product on a 7-point Likert scale. The direction of the scale was randomized between participants, such that for half of them "Very sustainable" was presented on the right end of the scale, and for the other half of the sample "Very sustainable" was on the left end of the scale. Moreover, within participants the same image was rated twice: once they were asked about the sustainability (as in the example here) and once about the unsustainability of the product packaging. Image reproduced from Pexels.

Before the question changed to (un)sustainable, participants had a break. When they finished both blocks, participants were debriefed.

### 2.1.2 Results

The product images and their mean ratings can be found in Supplementary material A.

The average NEP score was 3.60 ($SD = 0.46$) with Cronbach's alpha of 0.76 on this 15-item questionnaire. The average Health Consciousness was 5.46 ($SD = 0.92$), and Cronbach's alpha was 0.77 on the 4 items.

The average product packaging rating was 4.06 ($SD = 2.17$). There was no correlation between people with a higher environmental belief and their perception of product packaging sustainability (Spearman $rho = -0.13$, $p = 0.21$). Gender had no impact on product sustainability ratings [Wilcox $W(16.48) = 753$, $p = 0.91$].

There was no effect of left/right associations [$W(47.25) = 4{,}169$, $p = 0.51$], i.e., the direction of response options in the Likert scale (where unsustainable was presented either on the left or on the right) did not impact the ratings. Moreover, the difference between the (un)sustainable questions was not significant [$W(47.25) = 4415.5$, $p = 0.996$]: the answers on the questions "How sustainable do you perceive the packaging of this product" were not significantly higher than the question "How unsustainable do you perceive the packaging of this product."

Products with the highest sustainability ratings did not include any packaging, while the products with the lowest sustainability ratings were packed in more plastic than what is strictly essential for containing, transporting and preserving the product (Figure 3).

### 2.1.3 Discussion

In this study, the perception of packaging of products in the supermarket was investigated. This revealed that products without any packaging were perceived most sustainable while products packed in plastic were perceived the least sustainable. These images and their ratings were aimed to create a stimulus database for future researchers. For example, future research could use these stimuli as a baseline for interventions targeting consumers to consider waste-free product packaging more.

The images in this stimulus set were not explicitly matched in terms of product type or visual appearance. Since consumer behavior is performed on a daily basis and under high impact of external factors such as packaging visuals, texts and sizes (Orth and Malkewitz, 2008; García-Madariaga et al., 2019), it was important to incorporate as much ecological validity in the stimulus set as possible. In order to provide images that match reality as close as possible, we only removed the branding but kept packaging shapes, colors and product orientations intact. Although there were some identical products with different packaging in the initial dataset (such as cauliflower with and without packaging), these did not come forward as the strongest (un)sustainable products (which are shown in Figure 3). This led to the top and bottom products not being visually similar but instead providing the most extreme (un)sustainability contrast between packaging according to the sample.

## 2.2 Study 2: Affective images of nature

### 2.2.1 Methods

#### 2.2.1.1 Stimuli

Nature images promoting either positive or negative valence were gathered from three sources: (1) an openly available database of affective climate change images by Lehman et al. (2019) where images


FIGURE 3
Product images that were rated on the extremes of the sustainability scale. **(A)** Product images that were rated the highest on sustainability did not include any packaging, while **(B)** products images of which the packages were rated most unsustainable used extra plastic. These 18 images were implemented in Study 3 as extreme (un)sustainable packaging images. Images reproduced with permission of Albert Heijn. Images of potatoes in 3 **(A)** reproduced from Pexels.

were rated on relevance, arousal and valence on a 9-point Likert scale, (2) an openly available database of positive nature images by Dal Fabbro et al. (2021) that were rated on arousal and valence on a 1–9 Likert scale containing emoticons, and (3) images that were obtained from websites with creative licenses such as Pexels.com and Unsplash.com. Search terms such as 'waste' and 'pollution' were used to search for negative images. When a suitable image was found, a positive search term for that image was also used. For instance, if the selected negative image showed a polluted ocean, we would search for 'ocean' and 'water' to find its positive counterparts in the same context.

For images to be considered, we adhered to the following guidelines: the images should not contain text, people and graphs, signs, or otherwise designed stimuli. Following these inclusion criteria, we selected images from Lehman et al. (2019) with a valence rating below 4 as negative images and those with a valence rating above 6 as positive images. Similarly, from images of Dal Fabbro et al. (2021), we considered positive images with a valence above 7.4. For each context shown in these images, the image with the highest valence score was selected, but only if there was a negative contextual counterpart (i.e., the beach was selected when an image of a beach with waste was included).

From this initial selection of nature images, pairs of positive and negative images were further defined for the validation survey based on their source database ratings or our own interpretation when no rating was available. It was important to have contextually matched positive and negative images as the planned intervention in Study 3 and 4 conditioned the products in both directions. There was a clear representation of waste-related images in these defined pairs as they show the most direct effect of plastic packaging on the environment. For a few pairs, there were multiple positive images from the database that were fit for pairing; these were all included in the validation survey so that participants could choose the image to which they had the strongest positive reaction.

Moreover, 10 neutrally-valenced images (the 10 images that scored on the middle of the Likert scale for valence) from the database of Lehman et al. (2019) were included as distractors to ensure that participants' answers were not biased toward the extremes. In total, 35 images were included for validation (11 negative, 10 neutral and 14 positive images). The images included can be found in Supplementary material B.

#### 2.2.1.2 Participants

In total, 235 respondents (129 Male, 104 Female, 2 Non-binary, $M_{age} = 53.9$, $SD_{age} = 20.0$) were recruited using a panel agency. They received a small monetary reward in return for their participation in the experiment. The study was approved by the Research Ethics Committee of Tilburg School of Humanities and Digital Sciences (TSHD_RP123a). Prior to the experiment, respondents read an information letter and signed an informed consent form. The number of respondents was determined following Lehman et al. (2019), who conducted their study on 67 respondents, and Dal Fabbro et al. (2021) where the number of ratings per image was between 36 and 108. We decided to take the high aim of 108 ratings per image, which was consequently oversampled to an average of 130 ratings per image.

#### 2.2.1.3 Questionnaires

As in Study 1, demographics and the New Environmental Paradigm (NEP) were assessed. Images were rated on a 9-point Likert scale regarding the relevance, arousal and valence it evoked with the participant (Figure 4). The relevance of the image to climate change asked how strongly the picture was related to global warming, concerning both positive and negative relevance (e.g., if a positive scenery is very relevant to climate change, participants were instructed to rate a 9/9). Arousal was defined as how calm or aroused participants felt when watching the image. Arousal in this case referred to the strength of the participants' gut reaction to the image and served as a measure of stimulation or frustration elicited by the image. The valence was measured as the negative or positive emotion participants felt

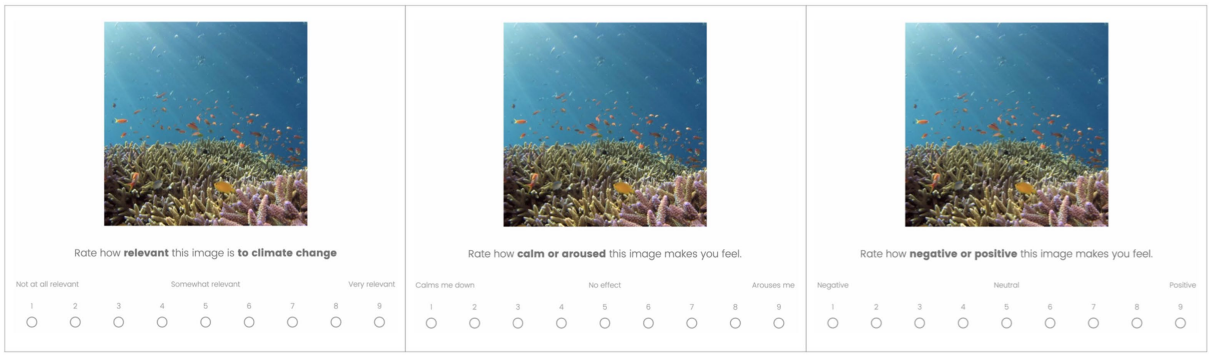


FIGURE 4
The rating task where subjects rated the relevance, arousal and valence they felt evoked by the image on a 9-point Likert scale. Images reproduced from Unsplash.

when watching the image. They were asked whether the image made them happy or sad/angry.

Lastly, participants performed a pairing task where a negative image was presented together with four neutral or positive images of which the participant had to choose one that in their view was the best positive counterpart of the negative image in terms of visual and conceptual objects (Figure 5). This pairing task served to identify the most appropriate matches in participants' opinions as for some negative stimuli, multiple positive counterparts were hypothesized by the researchers in the selection phase.

#### 2.2.1.4 Procedure

The survey was administered using Qualtrics. Participants read the information letter and were only able to continue when they agreed to the informed consents. First, participants performed the rating task where they evaluated a random subset of images (20 out of 35, in random order) on their valence, arousal and relevance to climate change on a 9-point Likert scale. Afterwards, participants performed a pairing task where negative images were presented together with four neutral or positive images that visually or contextually resembled them. Participants were instructed to choose one of the four images that they considered the most appropriate opposite of the shown negative image. To minimize fatigue and loss of attention, each participant rated a random subset of pairs (6 out of 11 pairs that were included in the study). Lastly, they answered demographical questions and the NEP questions. After that participants were debriefed.

### 2.2.2 Results

The selected climate-related images and their mean ratings can be found in Supplementary material B.

On average, images were rated by 130.56 participants ($SD = 2.74$, $min = 125$, $max = 136$). On average, the images were rated 5.90 ($SD = 0.94$) on relevance to climate change, 5.55 ($SD = 0.96$) on arousal and 4.93 ($SD = 1.41$) on valence.

The neutral images were rated slightly above the scale mean of five points: 5.35 ($SD = 0.47$) on valence [$t(9) = 2.35$, $p = 0.04$], although not significant on relevance [$M = 5.13$, $SD = 0.70$, $t(9) = 0.60$, $p = 0.56$], and arousal [$M = 5.18$, $SD = 0.34$, $t(9) = 1.62$, $p = 0.14$]. Negative images (valence $M = 3.04$, $SD = 0.38$) were significantly more arousing ($M = 6.63$, $SD = 4.86$) than positive images (valence $M = 6.02$, $SD = 0.71$, arousal $M = 4.86$, $SD = 0.34$) ($t(20.55) = 11.74$, $p < 0.001$, $CI = [1.46, 2.09]$, $d = 4.37$). Moreover, negative images were perceived as more relevant to climate change ($M = 6.83$, $SD = 0.47$) than positive images ($M = 5.31$, $SD = 0.63$) ($W = 293$, $p < 0.001$, $CI = [1.10, 1.97]$, $d = 0.752$).

The average NEP in the sample was 3.68 ($SD = 0.54$), Cronbach's alpha for this 15-item scale was 0.82. NEP was negatively correlated with average valence ratings per participant ($M = 4.93$, $SD = 0.96$) (Spearman $rho = -0.332$, $p < 0.001$, $CI = [-0.44, -0.21]$), indicating that participants with higher environmental belief on average rated all images lower on valence. A positive correlation was observed between NEP and the average relevance rating per participant ($M = 5.90$, $SD = 1.47$) (Spearman $rho = 0.162$, $p = 0.013$, $CI = [0.04, 0.28]$), indicating that participants with higher environmental belief also rated the images to be more relevant to climate change. For arousal, no such an effect was observed.

For all images, the highest match perceived by the participants on average was 50.05% ($SD = 13.10\%$), where the best match was between the positive and negative image of the turtle (79.84%) (Figure 6) and the worst match between hills of garbage and a healthy forested hill (35.93%), but this mainly had to do with the number of similar options available.

Consequently, from all climate-related images, six pairs (positive vs. negative) were selected for evaluative conditioning to be used in Study 3 and 4. These six pairs of images can be seen in Figure 6. The values under images present their valence, and the values in between images indicate the match rate of the pair and their difference in arousal. The selection was based on participants' pairing and how large the difference in valence ratings were. The average difference in valence evoked by this selection of pairs was 3.45 ($SD = 0.48$), where the average valence rating for positive images was 6.44 ($SD = 0.48$) and for negative images was 2.99 ($SD = 0.18$). The arousal ($M = 4.73$, $SD = 0.27$) and relevance ($M = 5.50$, $SD = 0.57$) ratings for positive images were lower than the arousal ($M = 6.87$, $SD = 0.10$) and relevance ($M = 6.98$, $SD = 0.11$) ratings for the negative images. On average, the match between the selected pairs as perceived by the participants was 53.95% ($SD = 15.54\%$), meaning that almost half of the participants selected the positive image in these pairs as being the best counterpart to the negative image presented (out of four choices).

### 2.2.3 Discussion

This study aimed to validate the climate-related images that were presented online and classify them into pairs of positive and negative

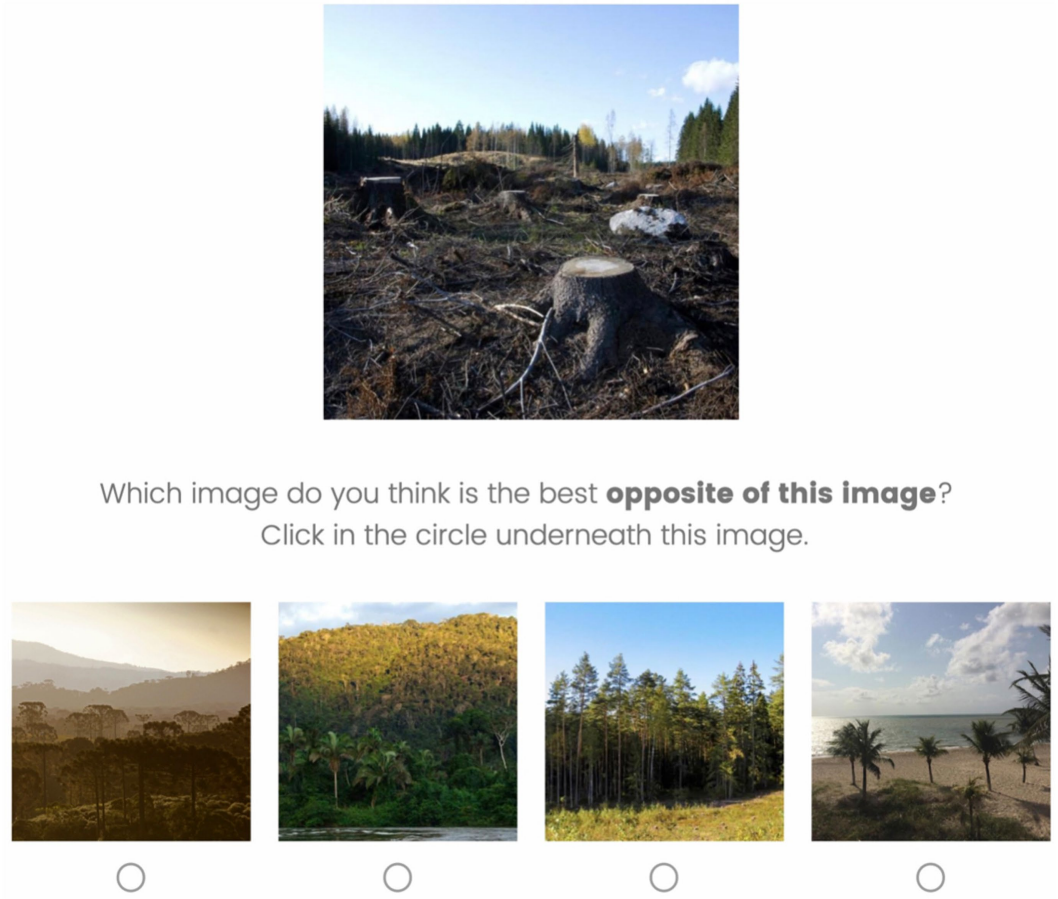


FIGURE 5
The pairing task where participants chose the image they thought was the best positive counterpart of the negative image shown. Image (top) reproduced under the terms of CC-BY 4.0 from Lehman et al. (2019). Images (bottom) from left to right reproduced with permission from e-NatPOEM (Dal Fabbro et al. 2021) image 099, image 064, Unsplash and e-NatPOEM (Dal Fabbro et al. 2021) image 393.

affect. Most pairs were matched by participants as we expected, there were only two images that were matched by the participants differently: the healthy forest (Figure 6E, left image) that we picked as possible match for the deforestation (Figure 6D, right image) served better in combination with the forest fire (Figure 6E, right image). Moreover, one of the neutral images (Figure 6F, left image) was perceived as the best positive counterpart for the image of the flooded village (Figure 6F, right image). The valence of this image was also perceived slightly above average and therefore created sufficient difference between positive and negative valence rating for this image pair.

Results were comparable with Lehman et al. (2019); they showed NEP scores indicating environmental attitude were correlated to the perceived relevance of the image to climate change, which was also observed in our sample. Moreover, negative images in the study of Lehman et al. (2019) were perceived more arousing in general, which is consistent with our findings.

The climate-related affective images collected and validated in this study can help future studies in in investigating environmental psychology and behavior. For example, researchers can use these images to evaluate how emotions and attitudes towards climate change can impact pro-environmental behavior. In conditioning paradigms, such a database could help improve interventions targeting the emotional component of pro-environmental behavior. Additionally, the images could be combined with text for example to examine responses to climate change information in the media.

## 3 Experimental validation

With the stimulus sets defined in Study 1 and 2, we pursued to examine the effect of evaluative conditioning as an intervention for pro-environmental attitude change. We did this in two steps; the first experiment (Study 3) aimed at exploring the impact of conditioning on products at the extremes of the sustainability scale, meaning that participants clearly perceived their packaging qualities to be either sustainable or unsustainable. The second experiment (Study 4) aimed at exploring the impact of conditioning on product images that received a rating around the midpoint of the sustainability scale, which meant there was no consensus about how (un)sustainable the packaging was.

The methods of both studies were identical, only the product images were different, but they were paired with the same climate impact images. The data collection for the two studies was conducted in two phases in order to reduce the number of trials and the amount of time required from the participants. In this chapter, we first report the similarities and differences in methods of Study 3 and 4, and then present their results together in the Results section to enable comparison.

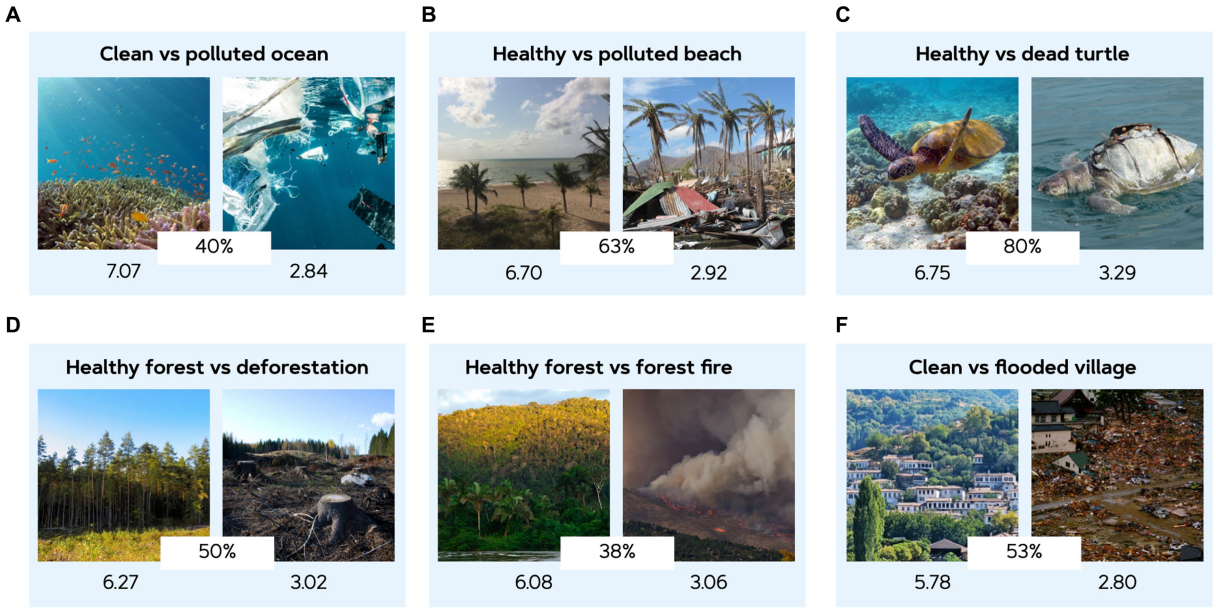


FIGURE 6
Pairs of affective (positive and negative) images that were selected in Study 2 based on their conceptual match as perceived by participants and the valence difference between them. These pairs are used in the following studies for evaluative conditioning. The mean valence score is provided below each image (on a 9-point Likert scale), with the most negative image being rated 2.80 (where 1 was the minimum value to be selected) and the most positive image being rated 7.07 (where 9 was the maximum value that could be selected). These image pairs served as conditioning stimuli in the consequent Study 3 and Study 4. **(A)** Images reproduced from Unsplash (1,2). **(B)** Images reproduced with permission from e-NatPOEM (Dal Fabbro et al. 2021) image 393 and under the terms of CC-BY 4.0 from Lehman et al. (2019). **(C)** Images reproduced under the terms of CC-BY 4.0 from Lehman et al. (2019). **(D)** Images reproduced from Unsplash and under the terms of CC-BY 4.0 from Lehman et al. (2019). **(D)** Images reproduced with permission from e-NatPOEM (Dal Fabbro et al. 2021) image 064 and from Unsplash. **(E)** Images reproduced under the terms of CC-BY 4.0 from Lehman et al. (2019).

## 3.1 Methods

We first describe the general methods for evaluative conditioning (sampling, procedure, questionnaires, tests, and analysis), then present the stimuli in each study and finally in the last subsection we report the analysis of both studies.

### 3.1.1 Participants

Before the experiment, a power analysis was conducted using G*Power (Faul et al., 2007) to determine the number of required participants in the study. The power was set at 0.95, the alpha level at 0.05, and the effect size of the primary outcome at $d = 0.50$, which followed a review on evaluative conditioning (Hofmann et al., 2010) and was used by Hollands et al. (2011). With the main analysis using a three-group ANOVA test, the required sample size would be 54 participants. In both studies, this number was oversampled (70 participants in Study 3 and 65 participants in Study 4) to ensure that after data rejection (see section Analysis of SAT) the sample size would still be sufficient. Participants were recruited from the university sample pool. They were all university students and received course credit in return for their participation in the experiment. The study was approved by the Research Ethics Committee of Tilburg School of Humanities and Digital Sciences (TSHD_RP123a). Prior to the experiment, participants read the information letter and signed the informed consent form.

#### 3.1.1.1 Study 3

For Study 3, a total of 70 respondents (17 Male, 51 Female, 2 Non-binary; $M_{age} = 20.74$, $SD_{age} = 3.44$) were recruited to participate in the online experiment. After preprocessing the data (see section Analysis of SAT for the exclusion criteria), 4 respondents were removed, leaving 66 participants in the analysis (16 Male, 49 Female, 1 Non-binary; $M_{age} = 20.58$, $SD_{age} = 3.10$). This sample size provided 80% power to detect an effect size of $r = 0.350$ or greater in a paired $t$ test with a 5% false-positive rate.

#### 3.1.1.2 Study 4

In Study 4, 65 respondents (25 Male, 40 Female; $M_{age} = 20.23$, $SD_{age} = 2.65$) were recruited to participate. After preprocessing the data (see section Analysis of SAT for the exclusion criteria), 4 respondents were removed, leaving 61 participants in the analysis (22 Male, 39 Female; $M_{age} = 20.26$, $SD_{age} = 2.71$). This sample size provided 80% power to detect an effect size of $r = 0.365$ or greater in a paired $t$ test with a 5% false-positive rate.

### 3.1.2 Procedure

The experiments were administered online using Qualtrics and could only be taken on desktop. An overview of the procedure is visualized in Figure 7. Participants read the information letter and were only able to continue when they signed the informed consent. First, demographics, New Environmental Paradigm (NEP; Dunlap et al., 2000), Health Consciousness (HC: Mai and Hoffmann, 2015; Koenig-Lewis et al., 2022) and attitude towards plastic packaging were assessed. After that, participants conducted the Sustainability Association Task (SAT) on 18 product images. This was followed by Evaluative Conditioning (EC) phase where participants received affective information about the products and their packaging via

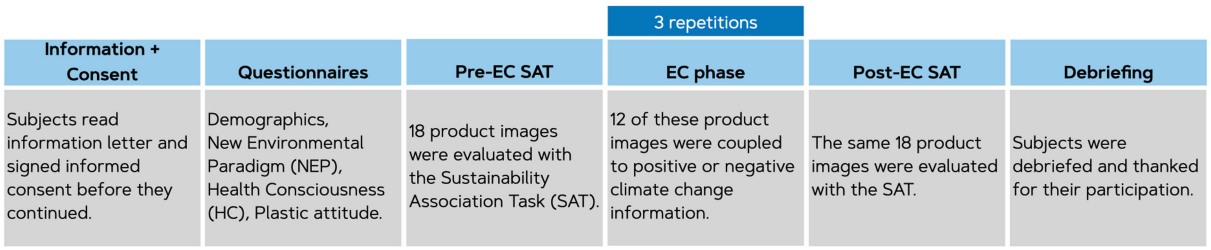


FIGURE 7
Overview of the procedure in Study 3 and 4.

climate-related images that were highly positive or negative on valence ratings. Positive information was provided for six products and negative information for six other product images (note that six products were not included in the conditioning phase at all in order to serve as control items). Each product image was shown for 1 s, followed by the climate image for 1 s. Then a fixation cross was shown with an inter-trial interval that varied between 800 and 1,200 ms before the next combination was shown. All combinations were shown three times (in three blocks) to ensure associative learning. In between every block, a grey circle was shown where the participant could choose to take a break and continue when they felt ready to do so. Once all three blocks were completed, the SAT was once again conducted to evaluate attitude change. Afterwards, participants were debriefed that the presented image combinations were not real but rather served as experimental manipulation. Finally, participants were thanked for their participation and the survey ended.

### 3.1.3 Questionnaires

The demographics questions assessed the gender and age of the participants as well as their responsibility for grocery shopping at least for most of their meals. Same as previous studies, participants' environmental belief was assessed by NEP (Dunlap et al., 2000), which includes 15 items answered on a 5-point Likert-scale, and Health Consciousness (HC) was measured by 4 items rated on a 7-point Likert scale (Mai and Hoffmann, 2015). Four questions about consideration of the impact of plastic packaging were added according to Weber Macena et al. (2021) where participants were asked to rate the extent to which they think about the negative impact of plastic packaging on the environment on a 1–7 Likert scale.

### 3.1.4 Evaluative conditioning

During the evaluative conditioning (EC) phase in both studies, positive information was provided for six product images and negative information for six other images. Moreover, six product images were not included in the conditioning phase at all in order to serve as control items. Each product image was shown for 1 s, followed by an affective climate image for 1 s. Then a fixation cross was shown with an inter-trial interval that varied between 800 and 1,200 ms before the next combination was shown. All combinations were shown three times, in three separate blocks (with a break in between) to ensure associative learning. In between every block, a grey circle was shown where the participant could choose to take a break and continue when they felt ready to do so. Before they could continue, a reminder was shown to evaluate the sustainability of the product packaging and not the product itself.

The affective image pairs used to facilitate the conditioning were the same in both studies. These were selected from the climate-related images gathered in Study 2. Six pairs (positive vs. negative) were selected for evaluative conditioning (Figure 6). The selection was based on participants' ratings of the contextual pairing and how large the difference in valence ratings were between both images. In both studies, six products were conditioned with positive affect, six with negative affect and six products were paired to no image at all.

#### 3.1.4.1 Study 3: Extremely (un)sustainable

Study 3 focused on EC applied to "extreme" products, i.e., products where respondents had a strong opinion about the sustainability level of their packaging. Therefore, the top (Figure 3A) and bottom (Figure 3B) nine products in the sustainability ranking were selected. The nine product images with the highest sustainability ratings ($M = 6.57$, $SD = 0.03$) did not include any packaging, while the other nine products with the lowest sustainability ratings ($M = 1.93$, $SD = 0.15$) were all packed in more plastic than what is strictly essential for containing, transporting and preserving the product.

The EC phase of Study 3 thus comprised of six conditions. Of the nine product images with the highest sustainability ratings (i.e., products with no packaging), three were paired to a positively-valenced nature image, three were paired to a negatively-valenced image and three products were not paired at all. This led to three experimental conditions for sustainable products where sustainability was reinforced, sustainability attributes were weakened, or there was no conditioning (i.e., sustainability perception should not be changed). Similarly, for the nine product images with the lowest sustainability ratings (i.e., products with wasteful packaging), three were paired to a negatively-valenced image (i.e., wastefulness association was reinforced), three were paired to a positively-valenced image (i.e., wasteful association was weakened), and three products that were not paired at all (the attitude should not be changed as no evaluative conditioning was provided). Assigning a product image to an EC condition was performed randomly for every participant. Data was calculated per person and condition. This means that for every participant, their responses to each group of product images (Sustainable vs. Unsustainable packaging; three products each) receiving one of the three EC conditions (either Positive, Negative, or No Affect) were summarized.

#### 3.1.4.2 Study 4: Uncertain about sustainability

Study 4 focused on EC applied to product images where respondents were uncertain about the sustainability level of their packaging. Consequently, 18 product images were chosen such that their rating was around the middle of the scale (4 on a 1–7 Likert scale; $M = 4.00$, $SD = 0.48$, min = 3.19, max = 4.96) indicating that the majority of participants rated them as "neither sustainable nor unsustainable." Their packaging was mostly recyclable, glass, beverage cartons or plastic nets (Figure 8).

Similar to Study 3, the EC phase comprised of three conditions. Six product images were paired to positively-valenced nature images, six other product images were paired to negatively-valenced images and six images were not paired at all. Assigning a product image to an EC condition was performed randomly for every participant. Data was calculated per person and condition. This means that for every participant, their responses to each of the three EC conditions (either Positive, or Negative, or No Affect; six products per condition) were summarized.

### 3.1.5 Sustainability Association Task

The perception of sustainability and wastefulness of each product image was assessed before and after the EC phase with the Sustainability Association Task (SAT). This task is based on the presumption that the strength of an association between an object (i.e., product packaging) and an attribute (i.e., sustainability) is reflected in the participant's response latency: when stimuli are easy to process (which is the case for objects and evaluations that are perceived to be congruent) participants respond faster to these stimuli (Fazio et al., 1986). Compared to the Likert scale, this may better represent the participants' opinion or cognitive process (Fazio, 1990; Fulcher et al., 2016). These basic assessments of object-evaluation association (Fazio et al., 1986) provide the basis upon which implicit tests have been developed (Greenwald et al., 1998; Kardes et al., 2019) and is preferred for the measurement of attitude accessibility (Fazio et al., 1989).

The SAT consisted of the presentation of a product image with the words *Sustainable* or *Wasteful* (one at a time) underneath. Participants answered whether they thought these words fit the packaging of the product using E (*No*) and I (*Yes*) keys on the keyboard (see Figure 9). Participants had 5 s to answer each trial. The timer was shown on top of the screen as a blue bar that was filling up. If participants could not answer on time, the test moved to the next trial. Before the task, there was a practice block where participants could practice the task with two product images and two associations (*Sustainable* or *Wasteful*, four trials in total). The practice block is not included in the analysis. After the practice round, participants were once again presented with the task explanation and a reminder to focus on the packaging of the product. Afterwards, they were granted 5 s to place their fingers on the keyboard to start the task. The SAT task was executed two times, pre-EC and post-EC, to assess how evaluative conditioning would change the perception of sustainability for the product packaging. Participants were reminded to focus on the packaging of the product before every task. The procedure was identical in both pre-and post-EC tasks.

### 3.1.6 Analysis of SAT responses

SAT responses were filtered when the response latency was below the lower boundary of 300 ms or above 5,000 ms as in Nosek et al. (2014). Participants were removed from the analysis completely if more than 10% of the SAT trials were filtered. Responses to trials with *Wasteful* association were re-coded such that *yes* meant unsustainable and *no* meant sustainable.

Data was summarized as one Associative Strength score per participant and condition, i.e., for each participant, we obtained scores that summarized their responses before and after conditioning per product category (Sustainable, Unsustainable, or Uncertain) and per conditioning type (Positive, Negative, No Affect). Moreover, for each


FIGURE 8
All product images that were used for evaluative conditioning in Study 4. They were rated to be neither unsustainable nor sustainable, indicating participants' uncertainty about their sustainability qualities. Images reproduced with permission from Albert Heijn.

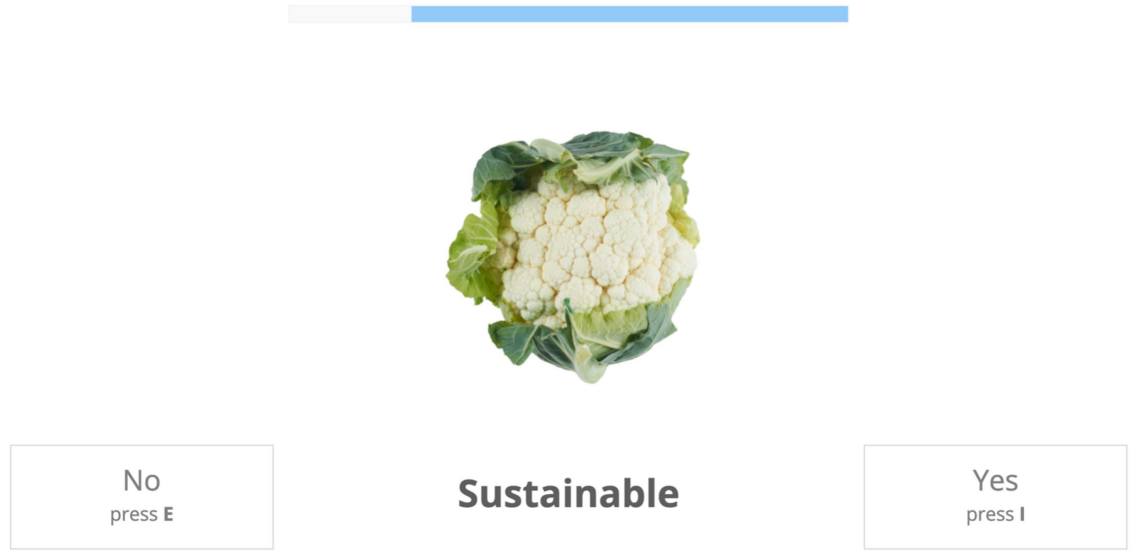


FIGURE 9
Example trial of the Sustainability Association Task (SAT). Eighteen products were presented with both words Sustainable and Wasteful (in total 36 trials). Participants had to press E (No) or I (Yes) within the time limit of 5s to demonstrate their perception of the product. Images reproduced with permission from Albert Heijn.

participant, the average pre-EC Sustainability Rating was reported as a comparison of initial sustainability perceptions in all EC conditions. This Sustainability Rating is the percentage of trials in which the participant answered *yes* when the word *Sustainable* was shown and *no* when the word *Wasteful* was shown.

The Associative Strength is calculated according to Equation 1 and reflects the strength of the sustainability association by combining the explicit sustainability rating and its response latency into one comprehensive value. The yes percentage (%yes) reflects the Sustainability Rating. $RT_{yes}$ and $RT_{no}$ are the averaged response latencies corresponding to those trials, and $RT_{mean}$ is the grand average of response latency over all trials in the pre-or post-EC tests for a specific participant. This grand averaging was employed in the equation to normalize the response latency values per participant and successfully reflect their variation between conditions and measurements, which is an important modulation in response latency research (Kardes et al., 2019). Response latencies ($RT_{yes}$, $RT_{no}$, and $RT_{mean}$) were reversed in the equation such that a shorter reaction time indicated a stronger association.

$$Associative\ Strength = \frac{\left(\%_{yes} \times \frac{1}{RT_{yes}}\right) - \left(\%_{no} \times \frac{1}{RT_{no}}\right)}{\frac{1}{RT_{mean}}} \quad (1)$$

Consequently, the obtained Associative Strengths from the pre-EC SAT were subtracted from the post-EC scores such that the difference resulting from conditioning could be compared per participant.

### 3.1.7 Statistical analysis

Associative Strength differences were compared in R (R Core Team, 2022) using repeated measures ANOVA from the R package rstatix (Kassambara, 2023) or Friedman Test from the stats package in case the assumption of homogeneity was not met following a Levene test. *Post-hoc* tests were done with paired *t*-tests or Wilcoxon Rank test when the data was not normally distributed following the Shapiro–Wilk test. *Post-hoc* tests assessed the change in Associative Strength caused by the conditioning in comparison to the NA conditioning and were corrected to a significance level of 0.025 following Bonferroni correction for two comparisons (Positive to NA and Negative to NA). Effect sizes were computed following Wilcoxon effect size from rstatix (Kassambara, 2023). Also, dplyr (Wickham et al., 2023) and ggplot2 (Wickham, 2016) packages were used for data exploration and visualization.

## 4 Results

From the SAT tasks in Study 3 and 4, two metrics are reported: the Sustainability Rating and the Associative Strength. The Sustainability Rating is evaluated before the EC to validate the initial product packaging perceptions. Afterwards, the difference in Associative Strength in response to the product images is reported, which is an implicit measure reflecting how strongly the product packaging was associated with sustainability. The raw SAT responses of each test are reported in the Supplementary material.

### 4.1 Sustainability Rating

The Sustainability Rating is the number of times the participant responded that a product is sustainable: either by answering *yes* when the attribute *Sustainable* was shown or *no* when the attribute *Wasteful* was presented. This metric is an explicit measurement of participants' opinion but since time pressure was added to the trial, the response alone could be an indirect measurement of the participant's attitude.

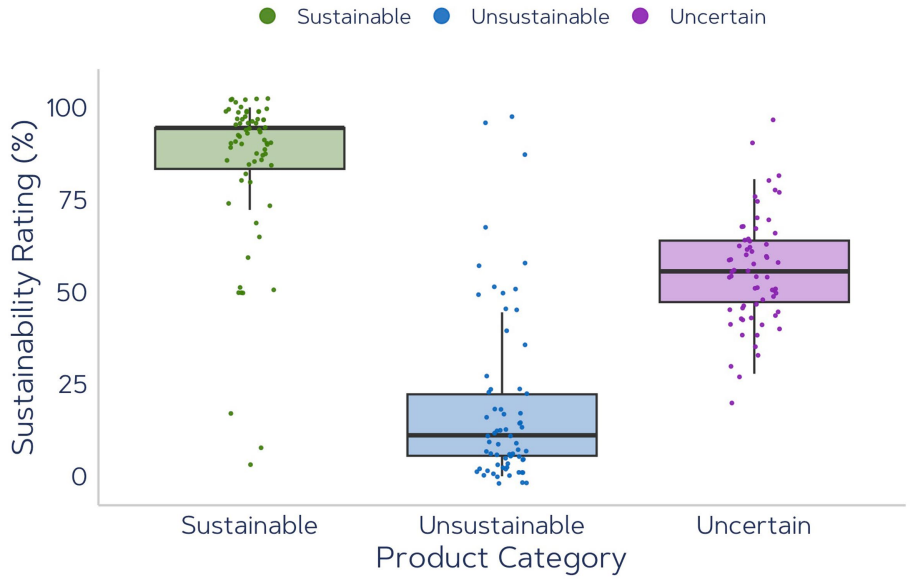


FIGURE 10
Averaged Sustainability Ratings per participant in pre-EC SAT for Sustainable products (average of nine sustainable products with two associations), Unsustainable products (average of nine unsustainable products with two associations), and Uncertain products that were rated neither sustainable nor unsustainable (average of 18 products with two associations).

Figure 10 demonstrates the Sustainability Ratings for product images with Sustainable, Unsustainable and Uncertain packaging categories before EC. As was expected and can be seen in Figure 10, for the products in the Sustainable and Unsustainable categories, the pre-EC SAT test showed considerably strong opinions: the median of sustainability ratings was at the top of the scale and at the bottom for the sustainable and unsustainable product categories, respectively. For the Uncertain product category, the median was around the middle, indicating that most people rated some of the product images as sustainable and a similar number of images as unsustainable. This reflects that the sample in this study has similar sustainability perceptions of the products compared to the participants in Study 1.

## 4.2 Associative Strength

The Associative Strength reflects the strength of an implicit response by incorporating the response latency into the explicit sustainability rating according to Equation 1. The Associative Strength differences between pre-EC and post-EC for all product categories (Sustainable, Unsustainable and Uncertain packaging) are displayed in Figure 11. For the Sustainable product category, Associative Strength did not show significant variations between Positive vs. Negative vs. No Affect (no conditioning) at all [$F(2,130) = 1.754$, $p = 0.177$].

For Unsustainable packaging category, a significant main effect was observed [$F(2,130) = 3.891$, $p = 0.023$, $\eta^2 = 0.014$]. However, post-hoc analysis between Positive EC ($Mdn = -0.120$, $IQR = 0.625$) and NA conditioning ($Mdn = -0.089$, $IQR = 0.748$) did not show significantly different changes ($W = 776$, $p = 0.036$), nor did comparison of Negative EC ($Mdn = 0.007$, $IQR = 0.609$) to NA conditioning ($W = 1{,}269$, $p = 0.298$).

For the Uncertain category, the change in Associative Strength scores was significantly impacted by the type of conditioning [$\chi^2$ (3) = 119.79, $p < 0.001$]. Positive EC ($Mdn = 0.119$, $IQR = 0.737$) compared to NA ($Mdn = -0.051$, $IQR = 0.592$) induced significantly greater change in Associative Strength ($W = 508$, $p = 0.002$, $CI = [0.11, 0.46]$, $r = 0.24$). Similarly, Negative EC ($Mdn = -0.229$, $IQR = 1.17$) significantly reduced the sustainability association ($W = 1{,}340$, $p = 0.005$, $CI = [-0.50, -0.09]$, $r = 0.22$).

## 4.3 Individual differences in conditioning effect

The previous analyses seem to indicate that evaluative conditioning affected the perception of packaging sustainability depending on the product category (Sustainable, Unsustainable, Uncertain) and conditioning direction (Negative, Positive, NA). The following analysis aims to investigate individual factors (such as gender, age, NEP, and Health Consciousness; HC) that could impact one's predisposition to conditioning effects and hence the change in Associative Strength after conditioning.

The average NEP was 3.58 ($SD = 0.44$) in Study 3 and 3.51 ($SD = 0.51$) in Study 4. Cronbach's alpha for this 15-item questionnaire was 0.68 in Study 3 and 0.81 in Study 4. The average HC in Study 3 was 5.30 ($SD = 0.94$) and 5.22 ($SD = 0.72$) in Study 4. Cronbach's alpha for this 4-item questionnaire was 0.66 in Study 3 and 0.55 in Study 4. The impact of plastic according to the participants in Study 3 was 5.10 ($SD = 1.13$) and 4.88 ($SD = 1.14$) in Study 4. Cronbach's alpha for 4-item questionnaire was 0.76 in Study 3 and 0.76 in Study 4.

For gender, a comparison of means was done for each conditioning type. Effects of age, NEP and HC were compared with linear regression. However, most personal factors had no effect on the conditioning results. NEP ($M = 3.59$, $SD = 0.44$, on a 1–5 Likert scale) and age ($M = 20.43$, $SD = 2.94$) did not impact the difference in Associative Strength between conditioned stimuli in a linear or

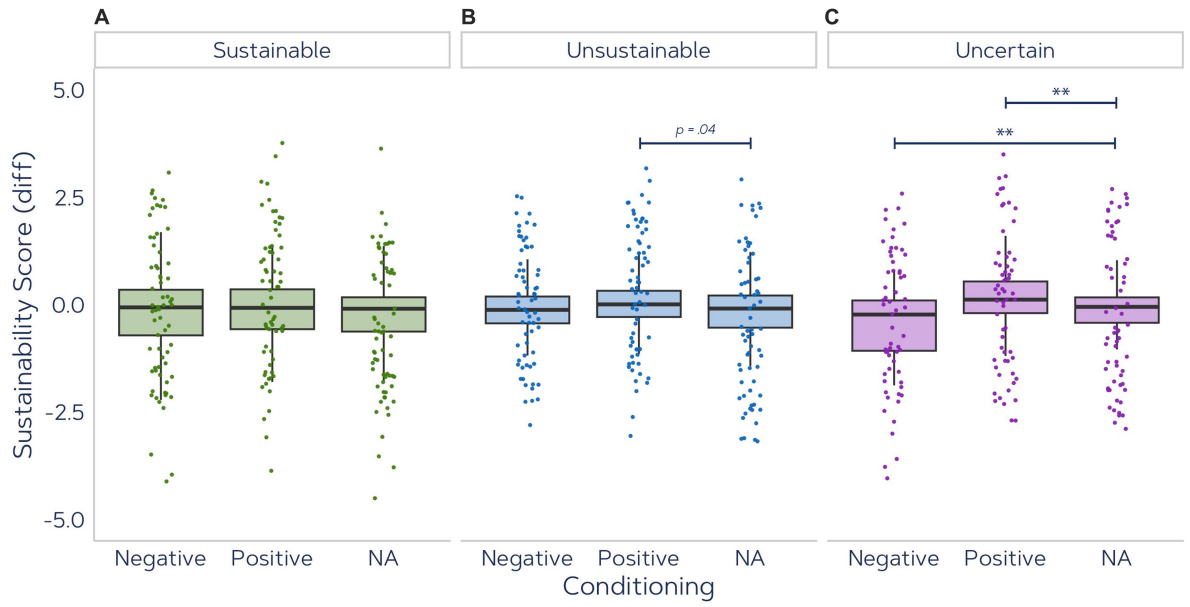


FIGURE 11
Averaged Associative Strength per participant for each condition in pre-and post-EC SAT tests for **(A)** Sustainable products, **(B)** Unsustainable products, and **(C)** Uncertain products that were rated neither sustainable nor unsustainable (**$p < 0.01$, *$p < 0.025$, $p$-values <0.05 are indicated with rounded values).

quadratic way. Gender, too, did not have any impact on conditioning effects, nor did NEP scores vary significantly between genders.

The only individual factor that was related to EC effect on Associative Strength was HC: for all products together, higher HC scores pointed towards decreased differences in Associative Strength after positive conditioning ($R^2$ $adj = 0.01$, $p = 0.050$, $CI_{\text{Intercept}} = [0.02, 1.27]$, $CI_{\text{HC}} = [-0.24, 0.00]$), but not after negative conditioning. This indicates that individuals who are more conscious of their health (as compared to individuals lower on HC), tended to show a greater increase in sustainable attitude after the stimuli were conditioned with images showing positive affect. The HC scores tended to be slightly higher for females than males ($W = 1{,}687$, $p = 0.056$).

## 4.4 Discussion

The results of Study 3 and 4 show that evaluative conditioning with climate-related affective images can be effective, especially for products with packaging that has ambiguous sustainability quality. This indicates that products for which consumers do not have a strong opinion can be effectively conditioned to be perceived as more or less sustainable. Pairing highly sustainable product images with positive images of nature and highly unsustainable product images with negative images of climate change did not change participants' perception of the product's sustainability. However, positive and negative conditioning of products with uncertain packaging qualities yielded significant changes in the hypothesized direction. There was also a slight trend for products with unsustainable packaging that were paired with positive images to be perceived as slightly less unsustainable.

Additionally, these effects of EC were not modulated by individual factors. Only health consciousness was an important factor for stronger conditioning with positive images. We initially hypothesized that NEP could have a quadratic effect on Associative Strength values, in the sense that individuals with low environmental belief would not be impacted by climate change images as they do not really care for the environment, whereas individuals with high NEP score would be better informed and thereby not impacted by (false) information provided in the experiment. However, we did not observe a quadratic or linear relationship in the data.

These results suggest that when designing evaluative conditioning interventions, one should pay attention to the observable (sustainability) attributes of the product and its packaging as the intervention might not be effective for highly evident ones. We also observed in our study that conditioning of highly sustainable products with a positive image did not yield more positive reactions in the post-EC test. The fact that the attitude towards extremely (un) sustainable product packaging is not easily changed was expected given the finding by Hofmann et al. (2010) that ambiguous stimuli yield stronger EC effects than strongly valued ones.

# 5 General discussion

The goal of this research was to examine the effectiveness of evaluative conditioning as a potential tool for future pro-environmental attitude and behavior change interventions. We conducted four studies in which we first compiled two validated datasets of supermarket products and climate-related affective images, and then used them to measure how coupling of affective images of nature and climate impact with product images can change people's perception of their (un)sustainability. Our results confirm our hypothesis that providing information about a product packaging's environmental impact using evaluative conditioning method can change people's perception towards that product image, although this effect is dependent on how the packaging was perceived in

terms of sustainability before conditioning. Especially when there is no consensus about the sustainability of the product image (as was the case with the Uncertain products in Study 4), conditioning using affective images of climate change could induce a considerably strong effect in changing people's attitudes towards it.

As our results from Study 3 show, both positive and negative EC did not have a significant effect on the perception of the product image, indicating that EC is not effective when a strong opinion about the product image already exists. Importantly, a trend was observed that positive information about unsustainable product images might slightly improve the sustainability perception of that image, while this was not the case with sustainable product images that were paired with negative affect. This was surprising at first because a stronger conditioning effect of negative images was expected as negative climate images can elicit higher arousal (Lehman et al., 2019), which we also observed in Study 2. However, the results did not show a stronger effect with negative images compared to positive ones for the uncertain product images in Study 4, and in Study 3 we found the opposite of the hypothesized direction: the positive images tended to change the perception of unsustainable product images while the negative images could not change the perception of sustainably rated product images. In our view, there could be several explanations for this observation: (1) the positive images are stronger in manipulation of the sustainability attitude than the negative images, although this is unlikely as in that case we would have observed a stronger effect with positive images for the uncertain products as well; (2) the attitude towards sustainable products is more robust than the attitude towards the unsustainable product category, which could also be a likely hypothesis when looking at Figure 10; (3) participants are more susceptible to receive positive information about unsustainable products than negative information about sustainable products. This last explanation could be interpreted in the context of motivated reasoning: participants might be more prone to accept contradicting information about unsustainable product images because it is more in line with their pre-existing beliefs or motivations (Palminteri, 2023). This is especially important to consider when referring to greenwashing: information about the negative consequences of a choice might be less likely to stick with the individual than the positive consequences of a decision.

Following the results of Carlson et al. (2019) who showed that images of climate change attract attention, especially in individuals with an environmental predisposition, we hypothesized that individuals with higher NEP scores would show a significantly larger change of sustainability ratings after negative conditioning. Previous studies showed that the effect of evaluative conditioning was stronger in participants who were on the extreme opposite of the conditioning direction. For example, Hollands et al. (2011) found that EC for healthy eating was only effective in individuals that were really unhealthy. Similarly, Koenig-Lewis et al. (2022) observed that individuals with higher health consciousness were not sensible to additional health motivation cues, whereas individuals with a lower consciousness of their health were highly stimulated by EC. However, we did not observe any effect of environmental predisposition on EC effects in our sample.

## 5.1 Limitations

In comparing the effect of conditioning on both product types (products with extreme and uncertain sustainability ratings), it is important to note they were tested in separate studies, which could impact the results. Testing the product groups separately was done to reduce the length of the study and ensure respondents were able to keep their attention. Additionally, this meant that the scores in the extreme (un) sustainable products were derived from three products averages (compared to six with the uncertain ones). It may have been the case that the discrepancy between obviously (un)sustainable made it easier for respondents to recall their initial response, or they denied the conditioning as they already felt a strong opinion about the products.

To measure individual factors, we relied on existing questionnaires in the literature. There is a wide variety of measurements that categorize participants in pro-environmental groups. According to Fishbein and Ajzen (2010) and the principle of compatibility, behavior can only be predicted by measures that are aimed at the same level of specificity (i.e., abstract behavior can only be assessed by abstract measurements). Since there are several measurements for environmental attitude, belief, and behavior, it might be that NEP is not the most compatible when correlated with the sustainability perception of daily products. Moreover, pro-environmental tendencies that occur automatically may be modified or overridden by slower reflective reasoning (Fazio and Olson, 2003), indicating that more implicit measurements of pro-environmental tendencies are perhaps better indicators of attentional processes than the explicit counterparts used in this study (Meis-Harris et al., 2021). Still, NEP is considered a powerful predictor of environmental concern (Xiao et al., 2019). Scholars agree that it measures the basis of ecological beliefs, and studies typically find that the NEP has considerable power in predicting pro-environmental behaviors (Xiao et al., 2019).

The effect sizes found for the conditioning of uncertain products were lower than the minimum detectable effect size calculated by the sensitivity analysis, which means that these results must be interpreted with caution. The observed effect sizes were also lower than the effect sizes reported by Hollands et al. (2011), which were used for *a priori* determination of sample size. The larger effect size in health conditioning performed by Hollands et al. (2011) indicates stronger conditioning effects for health-related problems that are more psychologically tangible and relatable to individuals whereas climate change is still an abstract and somewhat distant problem to many people.

Moreover, the longevity of the effects of the intervention could not be established from the current study, as the attitude change was only measured directly after the intervention. Previous studies have indicated that conditioning might have effects that exceed the duration of the experimental session: one (Houben et al., 2010) or two (Meijers et al., 2021) weeks after the intervention, effects were still observed. Especially when the affective combination is repeated multiple times (Hofmann et al., 2010), the effects may last beyond the duration of the experimental session, but longitudinal evidence should be collected.

## 5.2 Future research

While the results of our experiments indicate an effect of climate change images on people's perception of supermarket products (particularly in the context of product packaging and sustainability), it is widely debated whether such climate change images are appropriate for behavior change interventions. Studies have suggested that the pictures containing climate disasters could be depressing and more likely to lead to psychological distancing (Leviston et al., 2014)

and in-action (Schneider et al., 2017; Hornsey and Fielding, 2020). Meis-Harris et al. (2021) observed that individuals who actively engaged in pro-environmental behavior were paying more attention to environmentally harmful objects such as plastic bags, but not to beneficial objects such as reusable bags. However, other studies showed the opposite. Namely, for individuals who already engage in pro-environmental behavior, positive images of climate change solutions (such as solar panels) tend to capture more attention than negative images displaying climate change disasters (Carlson et al., 2020; Meis-Harris et al., 2021; Carlson et al., 2022). These inconsistent findings in previous research warrant more research to improve our understanding of individuals' susceptibility to various climate-related images and their effects on emotional responses. Images of climate change solutions were not included in the stimulus set proposed by this study but could be an interesting option for future research when investigating evaluative conditioning for pro-environmentally oriented individuals. Moreover, future research may consider increasing the variability of climate change images in the stimuli set to improve the categorical representation of positive and negative affect, which could increase the generalization of the conditioned response towards novel instances (Reichmann et al., 2023).

Our findings suggest that evaluative conditioning could change people's assessment of supermarket products before and after coupling with affective climate-related images, but future research is still required to examine how this change in perception is reflected in daily behavior. Additional questions for future research are why climate change images seem to be working and how their potential for pro-environmental behavior change interventions can be harnessed. In the current study, we could not identify all the relevant factors on an individual level that could lead to a predisposition to conditioning effects. Since we are not yet at a point where all individuals are considerate of the environment (Weckroth and Ala-Mantila, 2022), an approach that appeals to individuals with a lower concern for the environment might be more effective in promoting pro-environmental behavior among them. This calls for a personalized approach that captures individual attitudes, motivations and socioeconomic factors as well.

To dive deeper into the dynamics of individual factors, additional insight into the cognitive, emotional, and neurophysiological components of pro-environmental behavior and attitudes could be important (Leviston et al., 2014; Van Cappellen et al., 2018; Doell et al., 2021). Several studies have shown that emotional reactions to climate change play a part in pro-environmental behavior. However, next to the emotional component, cognition is also shown to be important. For example, memory or attention can be predictors of the EC effect (Corneille and Stahl, 2019), as well as mood and motivations (Sperlich and Unkelbach, 2022). Carlson et al. (2022) presented a working model for climate change psychology, arguing that interventions can be most effective in mitigating climate change behavior, when they also target the neural circuitry underneath. The same line of research was proposed by Leeuwis et al. (2022b) who recommended the investigation of the neural dynamics underlying pro-environmental motivations and behavior as a target metric for intervention design.

The positive results in conditioning observed here lead to the hypothesis that targeting interventions at an implicit level indeed may have an effect on cognitive and emotional drivers of pro-environmental attitudes and behaviors. Thus, to further investigate the cognitive and emotional components underlying evaluative conditioning for pro-environmental behavior change, we propose for future research to apply neurophysiological measurements to the proposed framework. For example, Bosshard et al. (2019) conditioned (dis-) liked brand names with (un-)pleasant sounds and observed that while there were no changes in explicit liking of the brands, variations were observed in neural measures: EEG frontal asymmetry increased for disliked brands when coupled to pleasant sounds and similarly decreased for liked brands that were coupled to unpleasant sounds. Moreover, differences in event-related potentials were observed after extensive sessions of evaluative conditioning (Kuchinke et al., 2015). Other metrics could focus on reward, valence, motivation, and engagement (Michaelsen and Esch, 2021; Sawe and Chawla, 2021; Leeuwis et al., 2022a).

Next, to the individual factors that play a role in pro-environmental attitudes and behavior, social factors could be further explored by (experimental) social psychology. For example, social influences and in-group norms have a strong effect on PEB (van Riper et al., 2019; Bouman et al., 2021; Cialdini and Jacobson, 2021). Strong individual evaluations may generalize to a social group (Moran et al., 2023), making it interesting to investigate the effect of evaluative conditioning in (several) members of a group.

The line of research into (evaluative) conditioning is still developing. As Moran et al. (2023) reviewed, some boundary conditions for successful conditioning are clear. For example, the evidence is clear that contingency awareness is essential for EC to be successful. This means that EC requires the participant to consciously notice the pairing of images (conditioned stimulus and unconditioned stimulus), but for EC to have effect, the participant does not need to be aware of the change in valence towards the conditioned stimulus after EC. To further understand the limits and possibilities of evaluative conditioning, more research in various application areas is needed, both tested inside and outside of the lab.

## 5.3 Practical implications

Since this study taps into real-life problems such as climate change, excessive consumption, and plastic waste, the implications beyond academic literature should also be discussed. Communicators such as journalists and scientists should be very careful with the information they distribute. False information may cause a (small) opinion shift in sustainability perception among consumers within only three repetitions. This is important to keep in mind when looking at the fake news movements.

This line of research could lead to the development of shopping and entertainment applications where emotional conditioning is used as a key asset in moving consumers towards more pro-environmental behavior. Nature images provide a strong cue in green advertising (Hartmann et al., 2013, 2023), making it an attractive asset for advertisers. For example, online social media could be used to pair products and images the same way it is implemented in an evaluative conditioning paradigm (Moran et al., 2023).

However, consumers and companies should be cautious about false communications and greenwashing. Greenwashing refers to the act of communicating sustainability qualities when the product (packaging) is indeed not (Walker and Wan, 2012). Next to the issue of morality and consumer misinformation, greenwashing has negative effects on the instances employing it; the inconsistency between a

(falsely) green attribute of a product and the accompanied higher price may have a negative effect on the consumers (Lee et al., 2018). Hence, green marketers should stay true to their mission when implementing evaluative conditioning. Simultaneously, evaluative conditioning could also be used as a tool to educate consumers on the true impact of certain products, packaging types or claims, in this way combatting greenwashing practices. Although, ways to do this still need to be further investigated (Volschenk et al., 2022; Álvarez-García and Sureda-Negre, 2023).

The environmental impact of packaging is still growing, but technology that is currently available can be useful to redesign the packaging paradigm (Escursell et al., 2021). We would like to encourage packaging researchers to further dive into the possibility of more sustainable production and material adoption. Meanwhile, the academic field of social psychology and cognition may focus on investigating the drive for consumers to make use of it.

## 6 Conclusion

This work presents the kick-off for further research into the affective underpinnings of pro-environmental behavior. In order to investigate the change in the sustainability perception of products that a consumer encounters daily, an openly accessible stimulus set in Study 1 was created containing 94 product images that were rated on the sustainability of their packaging. This showed that the most sustainable products were the ones that did not have any packaging at all, while the most unsustainable products were packed in an unnecessary amount of plastic. In Study 2, another openly available database was created with images of climate change and nature that were rated based on their relevance to climate change, arousal, and valence of response induced in the participants. Combining these two image sets, Study 3 and 4 aimed to investigate how these affective images could be implemented in an evaluative conditioning intervention to change the perception of product sustainability in participants. Our results showed that for products where participants were uncertain about the sustainability of their packaging, both negative and positive conditioning had a strong effect in changing the sustainability association toward the intended direction. However, for products with clearly sustainable or unsustainable packaging, the effect was negligible. These results provide ground for future research to further investigate the emotional dynamics that govern pro-environmental attitude and behavior. Additionally, by sharing the stimulus sets with the scientific community, we aspire to contribute to the open science movement in order to expedite efforts for mitigating the climate change problem.

## Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

## Ethics statement

The studies involving humans were approved by Research Ethics Committee of Tilburg School of Humanities and Digital Sciences. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

NL: Conceptualization, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. TB: Conceptualization, Supervision, Writing – review & editing. MT: Writing – review & editing. MA: Conceptualization, Supervision, Writing – original draft, Writing – review & editing, Methodology.

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## Conflict of interest

TB and NL are employed by the company Unravel Research. Authors' employment does not depend on the outcomes or publication of this study nor does it compromise the scientific integrity of the study in any way. Authors adhere to the code of conduct and research integrity guidelines of Tilburg University. The study was reviewed by the ethics board of the department of Tilburg School of Humanities and Digital Sciences. The authors declare no financial or competing interest, that is, the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



## Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2024.1284422/full#supplementary-material

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# Research on the negative effect of product scarcity appeals on the purchase intention of green products and its mechanism

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Studies have shown that product scarcity appeals affect consumers' perceived scarcity, willingness to pay, and other responses, and that scarcity appeal has the potential to cause consumers to pay higher attention to the product. However, there is a lack of research on the psychological responses of consumers to scarcity appeal from the perspective of perceived green washing. In this paper, three experiments are conducted to demonstrate the impact of product scarcity appeals on consumers' purchase intentions. The research shows that when green products use product scarcity appeals as a strategy, consumers' purchase intentions are affected, but consumers' information processing about the product is the most important determinant. Perceived green washing mediates the negative effect of product scarcity appeals on green product purchase intentions. And impression management motives moderate the negative effect of product scarcity appeals on green product purchase intentions. The findings of the study not only help companies to effectively adopt the right advertising strategies to improve their marketing effectiveness, but also help them to explore the market for green products.

KEYWORDS

**product scarcity, perception of deceptive, perceived green washing, theory of persuasion knowledge, motivation of impression management**

## 1 Introduction

In today's society, people gradually pay attention to the safety and health of the quality of life, and pay more attention to the relationship between consumer quality and sustainable development in the process of consumption. In fact, green consumption has become a core and enduring movement globally, one that is likely to strengthen as younger generations grow up and buy more green products from businesses at a higher rate than previous generations (Lu et al., 2013). Many companies have taken note of these requirements and responded positively to them by producing and offering green products that balance corporate, consumer, social and ecological interests and green marketing to meet the green needs of consumers. For example, in 2016, 190 Fortune 500 companies reported that they benefited from $3.7 billion in green products (WWF et al., 2017). Therefore, there are more and more green products on the market to meet the needs of consumers. Green products are those products that do not harm the environment and do not contain potentially harmful components, specifically, products that do not pollute the environment or destroy natural resources, can be recycled or

can save energy (Lin and Chang, 2012). Compared with ordinary products, green products have considerable pro-social properties (Wang et al., 2019). Correspondingly, green consumption behavior refers to consumers' daily consumption, which focuses on purchasing products that can satisfy their intrinsic needs while reducing the negative impact on the environment (Mao et al., 2017).

However, most consumers still have a weak awareness of ecological protection, and it is difficult to judge whether the product is green washing or not. Consumers also tend to have attitude-behavior differences in green consumption behavior, i.e., inconsistencies between individual attitudes toward green products and actual purchase behavior. In light of this, current research in the area of green consumption continues to explore how to motivate consumers to adopt green products. For example, there has been a lot of interest in how businesses can use effective strategies to communicate their messages to motivate consumers to respond positively to green products. Previous research has focused on advertising appeals, such as rational versus emotional appeals, self-interest versus altruistic appeals, guilt appeals, and concrete versus abstract appeals (Kareklas et al., 2012; Lin and Chang, 2012; Matthes and Wonneberger, 2014; Yang et al., 2015; Mao et al., 2017). It is worth mentioning that most studies mainly focus on the promotion effect of advertising appeals on green products, and few studies pay attention to their negative effects. Meanwhile, product scarcity appeals, as a common type of advertising appeals in marketing practice, have received more attention in the field of advertising research, and related studies have found that product scarcity appeals are a frequent promotional strategy used by businesses to attract consumers' attention and interest (Liu and Li, 2017; Chae et al., 2020), however, by combing through the literature on green marketing, it is found that its role in the advertising and marketing of green products is still less explored.

In addition, there are now studies on the mechanisms of consumer responses to product scarcity appeals in terms of perceived scarcity and psychological resistance. However, there are still relatively few relevant studies, and the lack of integrated research on consumers' psychological reactions to scarcity appeals from the perspective of perceived green washing is undoubtedly limiting the effective insight into the nature and comprehensiveness of the consumer scarcity effect. Product scarcity appeals can have an important impact on consumers' consumption motivation and behavior. Previous studies have found that when consumers are faced with a product with scarcity appeals, on the one hand, consumers' perceived competitiveness is aroused, thus prompting them to make promotional purchases; on the other hand, as consumers' persuasion knowledge increases, consumers' perception of deceptive is also aroused, thus prompting them to make defensive purchases. Previous studies have found that consumers' "sense of freedom" is awakened by the scarcity of information, as they feel restricted in their freedom of choice, which leads to stronger psychological resistance and reduced willingness to buy (Li D.J. et al., 2015; Li D.Y. et al., 2015).

In this study, the effects of product scarcity appeals will be discussed. In detail, this study will focus on product scarcity appeals, perceived green washing, and motivation of impression management for green products, specifically exploring the following issues: (1) What is the role of product scarcity appeals in green product advertising and marketing? (2) If there is an effect, what is the potential mechanism?

In this paper, the product scarcity appeals were manipulated by designing two different subgroups, the "scarcity group" and the "control group." Then, a marketing scenario was described in which the subjects were asked to evaluate their willingness to buy two products, and then they were asked to fill in the questionnaire items related to perceived green washing and motivation of impression management to reflect their psychological characteristics and willingness to buy green products with product scarcity appeals.

This paper has several managerial insights and theoretical contributions to the business and existing literature, respectively. First, this paper utilizes an experimental approach to investigate the mechanisms that influence consumers' willingness to purchase green products that use product scarcity appeals as a strategy. The study not only helps firms to effectively adopt the right advertising strategies to improve marketing effectiveness, but also helps them to explore the green market. The purchase of green products is one of the main ways to promote the green development of society, protect the environment and transform the traditional lifestyle of consumers into "green life." Therefore, the research of this thesis adds a certain theoretical basis for promoting the construction of ecological civilization and for consumers' participation in green consumption.

In addition, academic research on advertising appeals in green marketing currently focuses on several types of advertising appeals, such as self-interest and altruism appeals, rational-emotional appeals, guilt appeals, and concrete and abstract appeals, while product scarcity appeals, which are common in marketing practice, have been less explored. This study examines the effect of product scarcity appeals on the purchase intention of green products in a green product purchase context; meanwhile, while previous studies have mainly explored the positive effects of advertising appeals, this study examines the negative effects of a common type of advertising appeals in practice, product scarcity appeals. This study enriches the existing research on product scarcity appeals.

## 1.1 Literature review and hypotheses development

### 1.1.1 The influence of product scarcity appeals on the purchase intention of green products

Product Scarcity Appeals (PSA) refers to the use of advertising or marketing to increase the attractiveness of a product, giving the public the idea that the product is in short supply in order to arouse consumers' attention and purchase (Eisend, 2008; Aguirre-Rodriguez, 2013). Merchants usually express the scarcity appeal of a product by highlighting the shortage of the quantity of the product. It is found that when the demand for a good increases and the quantity of the good is short, the public who want to buy the good will increase their value judgment and purchase urgency (Xu et al., 2021). For example, merchants often use hunger marketing, special offers, and limited supply to create an atmosphere of oversupply of goods, so that the public cannot immediately own the goods while making the public aware of their popularity. Numerous studies have found that product scarcity appeals increase the value of the product while promoting the sales of scarcity type products (Bozzolo and Brock, 1992), thus leads to greater product expectations, more purchases, shorter search times and higher purchase satisfaction (Xu et al., 2021), and of course, more positive willingness to pay and purchase (Eisend, 2008; Huang et al.,

2020). However, it has also been shown that publicizing the oversupply of a commodity does not cause the public to pay attention to the extent of the commodity and its value assessment, and that the exact effect depends on the cause of the scarcity (Lazaroiu et al., 2019) and the consumer's information processing of scarcity appeals (Eisend, 2008; Aguirre-Rodriguez, 2013). The reasons for the increase in demand for goods include environmental and human factors; the increase in demand due to environmental factors is difficult to promote the purchasing behavior of the public, and the increase in demand due to human factors tends to make the public willing to purchase and purchase behavior (Verhallen and Robben, 1994). At the same time, consumers with purchasing power are difficult to increase their willingness to purchase and consumers with weaker purchasing power are more likely to generate purchase ideas (Xu et al., 2021). Even the increase in demand due to artificial factors has different purchasing effects on the general public. For example, for the case where the supply side does not change the supply of the good and for the case where the product cannot meet the market demand, the two have different scarcity effects (Verhallen and Robben, 1994). In the case of intentional limited supply, consumers may experience perceived green washing and psychological resistance, and the consumer's desire for exclusivity or uniqueness is reduced (Román and Ruiz, 2005). Thus, product purchase behavior for two different reasons of scarcity and types of scarcity can have different effects on consumers' value judgments and purchase intentions.

Rational and emotional needs, altruistic needs, and weighing environmental benefits are mainly used in the advertising of green products. Yang et al. (2015) suggest that abstract advertising can be used to emphasize altruistic benefits of green products, thus increasing consumers' desire to purchase. However, studies such as Darke and Ritchie (2007) and Riquelme and Román (2014) found that as consumers become more experienced and their persuasion knowledge increases, they are increasingly likely to process incoming advertising messages defensively and thus are more likely to develop perception of deceptive. It has also been shown that consumers are also increasingly inclined to speculate on the intentions behind the operation of scarcity advertisements, and if perceived deceptive will thereby reduce their willingness to purchase the product (Chaouachi and Rached, 2012; Mukherjee et al., 2012). Consumers are more likely to be influenced by information dissemination factors in the process of making purchase decisions on green products (Lin and Chang, 2012). Hence, consumers facing green product advertisements that express product scarcity appeals are more likely to be deceived and resistant, thus reducing their desire to buy green products (Majerova et al., 2020).

Persuasion knowledge theory refers to the personal knowledge that consumers acquire over time to reasonably respond to various persuasion strategies of marketers in order to ultimately achieve their goals (Friestad and Wright, 1994). Once consumers have more persuasion knowledge, they can more easily identify, analyze, interpret, evaluate, and remember the intent of various persuasions, and then choose and implement responses that they consider appropriate and effective, thus reducing the likelihood of being deceived. After the emergence of the theory of persuasion knowledge, relevant studies explaining consumer behavior gradually shifted from a passive perspective to a focus on individual initiative. In fact, Mobbs et al. (2020) found that consumers confronted with exposed information engage in both precision and defensive processing. Defensive processing makes consumers trust the information less. Some studies have confirmed that consumers process information defensively mainly due to two aspects. One of them is to avoid the aggression that comes from advertising messages (Darke and Ritchie, 2007); on the other hand, it stems from consumers' aversion to risk, and they will avoid losses caused by not being able to accurately identify deceptive messages. Therefore, it has been confirmed that when persuasion knowledge is enhanced by defensive focus, consumers tend to be wary of being deceived by manipulative advertising deception. Product scarcity appeals, on the other hand, are often a distinctive feature of virtual products in virtual product consumption contexts. Due to the vague product concept and lack of physical presence, consumers perceive greater risk and are thus more prone to perception of deceptive in certain contexts (Li D.J. et al., 2015; Li D.Y. et al., 2015; Liu et al., 2017). Research in areas related to green products, Lee et al. (2015) in the process of exploring the dissemination of product scarcity appeals, also pointed out that if consumers subjectively perceive signs that corporate activities will intentionally lead them to consume, they will have negative evaluations of corporate products, and consumers are largely influenced by emotions in the process of purchasing green products, and the expression of scarcity appeals for green products are more likely to play a negative role in consumers' willingness to purchase. Scholars such as Aguirre-Rodriguez (2013) argue that once consumers have a higher level of persuasion knowledge, they are less likely to favor purchasing goods that have advertising scarcity appeals. Specifically in the case of green product purchases, the expected guilt generated by consumers not purchasing green products due to self-responsibility is diminished, thus reducing purchase intentions.

In summary, the following hypotheses are proposed in this paper:

> *H*1: Product scarcity appeals will have a negative effect on the willingness to purchase green products.

## 1.2 The mediating role of perceived green washing

The term "green washing" is a hybrid of the words "green" and "whitewash," and is a proxy for false corporate environmental claims as well as whitewashing practices (Bowen and Aragon-Correa, 2014). In the 1990s, the concept of "green consumption" became prevalent in developed countries such as the United States, and many companies began green washing in response to this market trend. Over the past few years, green washing has become a common occurrence in companies due to a combination of the market's move toward a green economy, the prevalence of green concepts, and inadequate regulation (Lyon and Montgomery, 2015). Some of the representative greenwashing activities include targeting the company's achievements in environmental protection to hide the pollution generated in the production process, or falsely reinforcing the positive impact of the product's green features on the environment (Li D.J. et al., 2015; Li D.Y. et al., 2015). In addition, one-sided glittering generality and "verbal environmental protection" are also common tactics that consumers can perceive as corporate greenwashing behavior (Yang et al., 2020; Huang and Lei, 2021). With the emergence of corporate green washing, it makes consumers think more when they are

confronted with green perceived marketing messages and will discern the authenticity of green messages. When most consumers believe that green products are a marketing strategy used by companies, their perceived green washing increases and they do not believe the information provided by companies that the products are "green." Consumers' perceived green washing, i.e., their judgment of the authenticity of green information, will affect their consumer attitudes and their attention to green products. In essence, perceived green washing is also a kind of perception of deceptive, and most existing studies have explored the negative effects of perceived green washing on consumers' green purchasing behavior from the perspective of green purchasing. For example, Wu (2014) showed that perceived green washing affects consumers' perceived green quality and green satisfaction, and ultimately affects consumers' green word of mouth, which is an important factor influencing consumers' purchase intentions. Nyilasy et al. (2014) found that when there is a role between the interaction of green advertising and the environmental performance of a company, the environmental performance of a merchant is lower and consumers will initiate perceived green washing and believe that the green information provided by that merchant is false, which also has a significant negative impact on brand attitudes. Chen and Chang (2013) and other scholars found that consumers' perceived green washing not only increases confusion and green perception risk in green consumption, but also has a significant impact on trust in green products. Therefore, the level of consumers' perceived green washing affects their green purchase intentions; the lower the perceived green washing, the higher the consumers' purchase intentions; the higher the perceived green washing, the lower the consumers' purchase intentions.

Therefore, if green products are promoted using product scarcity appeals, consumers are likely to perceive such promotion as a strategy for companies to promote themselves as green and environmentally friendly to gain social reputation, rather than really wanting to produce green products, because these products are "scarce" or even high-priced, and consumers may think that companies do not want to produce them in large quantities for the sake of environmental improvement, and thus consumers may have perceived green washing, which affects their willingness to buy the products.

Based on the above analysis, the following hypothesis is proposed in this paper:

> *H2*: Perceived green washing mediates the negative effect of product scarcity appeals on willingness to purchase green products.

## 1.3 The moderating effect of motivation of impression management

Grant and Mayer (2009) suggest that motivation of impression management plays a positive role in citizens engaging in pro-social behavior, and Finkelstein and Penner (2004) explain motivation of impression management as the expectation to maintain a positive external impression and to be present frequently in environmentally relevant scenarios. When consumers receive praise from others for their first experience with a green product, they are more likely to repeat the purchase repeatedly, thus receiving more praise to improve their image in the eyes of others. This is because most consumers perceive their image as being "dignified" when they engage in such activities and, conversely, "disgraced" when they do not receive positive comments (Goffman, 2023). Whether or not one is dignified is an important point that people give importance to under the influence of Confucianism (Dong and Zhang, 2024). Therefore, consumers are more inclined to behave in a pro-social manner for the purpose of maintaining "dignified" and thus receive external praise.

The purchase of green products can not only be praised by others, but can also help consumers to improve their moral quality by leaving a good image in their mind through such a purchase. Researchers such as Gierl and Huettl (2010) argue that consumers will increase their dependence on scarce products if they are satisfied with the conspicuousness of such products. This is because interpersonal comparisons in everyday life and the desire to be affirmed by others increase the need for consumers to influence their status in society by using and purchasing scarce products from which they receive compensation for their ego. Wu (2014) suggests that it is known from altruistic studies of green products that consumers will increase their demand for green products prompted by motivation of impression management. Therefore, if the motivation of impression management is strong, the chances of repeated purchase of green products by consumers will subsequently increase.

Motivation of impression management is inseparable from green consumption behavior. Green consumption behaviors (e.g., green product purchases) are pro-social behaviors (Wang et al., 2019), and Grant and Mayer (2009) point out that motivation of impression management drives people to make pro-social and altruistic moves. In addition, Griskevicius et al. (2010) state that consumers purchase green products because this behavior carries altruistic characteristics, which can show or maintain the status of the individual, among others. Because altruism reflects the motivation to bear the cost of expenses because of others, in non-private situations or when the price of green products is higher, consumers will be willing to purchase green products to improve their status. Taken together, people will conduct activities in accordance with socially esteemed codes of conduct and concepts because they are in the purpose of impression management, even sometimes at the expense of personal interests, in order to gain prestige and a good impression in the eyes of others (Finkelstein and Penner, 2004). Whereas purchasing green products is an easy path for consumers to get social praise and improve their image, consumers' willingness to purchase green products changes because of the intensity of motivation of impression management (Wu, 2014), which also fits with the purpose of impression management.

In previous studies, it was concluded that most consumers are prone to impulsive consumption (Lee et al., 2015) because they are induced by a consumption philosophy that "scarcity means value" and that some consumers will consume excessively and competitively because of "scarcity" addiction. Barton et al. (2022) had found that consumers believe that buying so-called scarce products is a sign of self-efficacy and a symbol of a "savvy" shopper. Thus, in general, the scarcity appeal of green products can facilitate product purchase by consumers with high motivation of impression management in two ways. First, the purchase of green products is a pro-social act, and consumption of green products may lead consumers to believe that they will make a good impression on others or enhance their moral image, so consumers with high motivation of impression management may prefer green products promoted with scarcity appeals to those

with low motivation of impression management, and perceived green washing is lower. At the same time, "scarce" green products are often in short supply and can, to some extent, reflect a consumer's uniqueness or even status, so consumers with high motivation of impression management may prefer green products promoted with scarcity appeals and have lower perceived green washing than those with low motivation of impression management.

Accordingly, this study proposes a second hypothesis:

> *H3*: Motivation of impression management moderates the mediation of perceived green washing in product scarcity appeals on green product purchase intentions.

Figure 1 shows the complete conceptual model.

## 2 Pretest of the three experiments

The pretest was divided into two parts, which focused on the initial testing of the experimental stimulus materials, methods, and design that would be used in the three formal experiments that followed. In detail, the first part was to select valid stimuli for the later experiments. The second part was to ensure the validity of the methods and scales used in the formal experiments.

### 2.1 Experimental design and subjects

The whole experiment was divided into two parts, firstly, in the first part, before the formal experiment started, this study referred to the experimental process of Liu et al. (2017) and Wang et al. (2018) to determine the green products needed for the formal experiment. Detailed steps: firstly, through literature review and interviews, based on consumers' daily life habits, products with scarcity appeals as advertising used in this study were identified as experimental materials. That is, through group talks, we selected five green products that consumers are more closely involved in their daily lives: recyclable paper bottles, recycled printing paper, biodegradable plastic, green paint, and environmentally friendly fabrics. In the second step, we recruited 30 college students from a university in southern China by means of a simple questionnaire to measure their definitions of the attributes of these products, the likelihood of daily purchases, and their judgments of whether these products were green. We referred to the scales of Liu et al. (2017) and Wang et al. (2018), translated the scales into Chinese, and invited scholars in related fields to suggest modifications. The survey results showed that the ratings of these products were 100, 80, 90, 85, and 95%. This led to the determination that these five products were identified as green products in everyday life. Finally, this thesis selected the highest rated eco-friendly fabrics, recyclable paper bottles and biodegradable plastics as stimuli to be measured in the subsequent experiments.

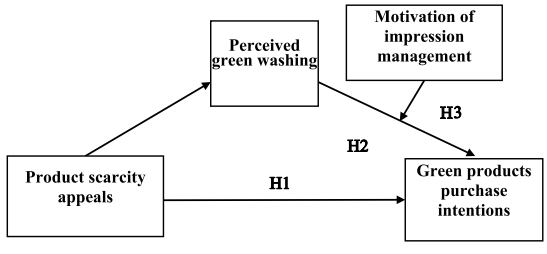


FIGURE 1
Conceptual model.

The second part was a pretest of the scarcity appeal, perceived green washing, motivation of impression management and purchase intention scales that will be covered in the main experiment. The material of the pretest was selected as the stimulus for the first part, which was "eco-friendly fabric." 46 college students were recruited from a university in southern China and randomly divided into a scarcity group and a control group to read two materials about environmental fabrics. The experimental results of 40 valid subjects were obtained by this experiment after eliminating invalid samples ($M_{age}$ = 24.38, $SD_{age}$ = 3.53; 55% female). The contents of the materials were:

Control group: "fast fashion" provides the current popular styles and elements, it is characterized by low price, more models, more quantity, the current fiber clothing, chemical fibers have become an important part of the textile fiber. Common synthetic fibers are nylon, polyester, etc. They all obtain raw materials from petrochemicals to synthesize polymer, and then draw into fibers. Although there is some harm to the environment, but because the raw materials are cheap and easy to obtain, can stimulate the interest of consumers, the annual production of clothes are very considerable, can meet the market demand to the maximum extent.

Scarcity group: With the ultimate alarm bell ringing about environmental pollution and energy crisis, more and more eco-friendly clothes are appearing on the market. In order to redeem the negative image in consumers' minds and to make current and future fashion more sustainable, a brand has set up an eco-friendly collection exclusively. It provides fashion for environmentally conscious customers, promotes concern for climate change, reduces waste, and reuses and recycles. The collection is designed to reduce the negative impact of clothing on the environment throughout its life cycle and to increase the recycling rate of textile fibers so that they can be fully reused. However, as the collection of old fabrics is limited in quantity and color, most of the processed eco-friendly clothes are limited edition.

### 2.2 Experimental procedures

After the subjects read the pairs of materials individually, they were asked to rate the product scarcity within the materials. If the product scarcity appeal rating for the scarcity group was lower than the product scarcity appeal rating for the control group, then this sample was of the control group type, and if it was higher then it was of the scarcity group type. To determine the validity of the experimental material, we used the questionnaire questions used in White and Peloza (2009) and Liu et al. (2017) studies and measured them on a 5-point Likert scale (1 = not at all scarce, 5 = very scarce). The questions on the motivation of impression management scale were "I want to present myself in a positive way to others" and "I want to make a positive impression on others" and so on (1 = strongly

disagree, 5 = strongly agree; α = 0.799). Subjects were also asked to answer questions on the perceived green washing scale, such as "I think the product's environmental promise is trustworthy" and "I think the product's environmental appeals are trustworthy" (1 = strongly disagree, 5 = strongly agree; α = 0.864). In addition to the questions on the green product purchase intention scale, such as "I would recommend my relatives and friends to buy this product" and "I would like to collect and learn more information about this product" (1 = strongly disagree, 5 = strongly agree; α = 0.856). Statistical analysis of the reliability and validity of the scores given by the subjects to the scale items was carried out by SPSS 26, and the results were shown in Table 1, which showed that the reliability and validity of all the scale items were above the standard.

## 2.3 Results

### 2.3.1 *T*-test

By performing an independent samples *t*-test on the two groups of data in the scarcity and control groups, the results show that there is no significant difference between the two groups in terms of perceived green washing ($t = -1.018$, $p > 0.05$); no significant difference in motivation of impression management ($t = -0.343$, $p > 0.05$); and a significant difference in purchase intention ($t = 3.606$, $p < 0.05$).

# 3 Experiment 1

The purpose of experiment 1 was to verify whether the negative effect of product scarcity appeals on green products purchase intentions holds true.

## 3.1 Experimental design and subjects

A (scarcity group vs. control group) single factor experimental design was used for experiment 1. The same experimental materials as well as methods were used as in the pretest, and 110 undergraduate students from a university in southern China were used as subjects in this experiment. The data of subjects who did not meet the requirement of filling in the data were eliminated according to the principle of completing normality, and a total of 100 valid sample numbers were finally obtained ($M_{age} = 24.21$, $SD_{age} = 3.32$; 54% female).

## 3.2 Experimental procedures

The experimental stimulus used in this thesis was an advertising message from the Internet and other media looking for relevant green products with product scarcity as appeals, thus forming the experimental material. The experiment began by randomly assigning 110 students from a university in the south to the two groups mentioned above, which were divided into a scarcity group and a control group. Then the purchase intention of the students in the two groups was measured separately by the purchase intention scale. Each subject participating in this experiment received a small gift after completing the experimental task independently. A marketing scenario was used to manipulate the subjects' perceptions of product scarcity of green products by having them read a self-compiled material. The experimental starter materials for both the product control and scarcity groups were used from the pretest.

After reading the material, in order to determine the validity of the experimental material, subjects completed the questionnaire questions used in our study by White and Peloza (2009) and Liu et al. (2017) which were measured using a 5-point Likert scale. After reading the material, subjects continued to rate their perceived emotions on a five-point scale (1 = not at all scarce, 5 = very scarce). The subjects were also asked to answer the questions about their purchase intentions about green products in the questionnaire, and to choose the corresponding score according to their level of agreement after reading the materials and their level of agreement with each statement (1 = strongly disagree, 5 = strongly agree).

## 3.3 Results

Experiment 1 first divided the respondents into a scarcity group and a control group, and after excluding the invalid sample, the results of the data collected showed that there were 55 respondents in the scarcity group and 45 respondents in the control group. The hypotheses were tested by one-way ANOVA. In order to exclude the influence of control variables such as gender, age and education on the experimental results, we added gender, age and education together with product scarcity appeals as independent variables to the model. The significance of the corrected model $p = 0.000 < 0.05$ showed that the current model had independent variables that had a significant effect on the dependent variable. The model fit was 0.353, which met the general linear model general criteria. The results of the between-subjects effect test showed that product scarcity appeals had a significant effect on purchase intention in the model ($F = 53.52$, $p = 0.000 < 0.05$). From the mean comparison results, it was concluded that the mean value of willingness to purchase green products was lower in the scarcity group ($M_{scarcity} = 2.261$, $SD_{scarcity} = 0.737$; $M_{control} = 3.336$, $SD_{control} = 0.727$). Thus the negative effect of product scarcity appeals on purchase intention holds.

## 3.4 Discussion

Experiment 1 initially confirmed the relationship between product scarcity appeals and consumers' purchase intentions by initiating subjects' perceptions of product scarcity and testing that purchase intentions in this scenario were consistent with hypothesis 1 of this paper, which states that subjects have lower purchase intentions for green products with product scarcity appeals. But the specific reason for the relationship between the two is unclear. In this regard, Experiment 2 was designed in this paper to verify the mediating role of perceived green washing between product scarcity appeals of green products and consumers' purchase intentions by using questions to initiate subjects' perceived green washing.

TABLE 1 Results of reliability and validity analysis.

| Variables Liu et al. (2017) and White and Peloza (2009) | Items | Cronbach's α | KMO | CR | AVE |
|---|---|---|---|---|---|
| Motivation of impression management | I want to present myself in a positive way to others | 0.793 | 0.716 | 0.921 | 0.716 |
| | I do not care what people think of me | 0.784 | 0.743 | 0.936 | 0.725 |
| | I want to make a positive impression on others | 0.854 | 0.836 | 0.911 | 0.852 |
| | I want to make myself look good to others | 0.762 | 0.766 | 0.908 | 0.734 |
| Perceived green washing | I think the product's environmental promise is trustworthy | 0.833 | 0.799 | 0.921 | 0.843 |
| | I think the environmental performance of this product is reliable | 0.818 | 0.822 | 0.918 | 0.801 |
| | I think the product's environmental appeals are trustworthy | 0.764 | 0.742 | 0.943 | 0.746 |
| | The product's concern for the environment is in line with my expectations | 0.739 | 0.803 | 0.883 | 0.728 |
| | The product is committed to protecting the environment | 0.798 | 0.747 | 0.908 | 0.832 |
| Green product purchase intention | I would like to collect and learn more information about this product | 0.821 | 0.838 | 0.919 | 0.811 |
| | I would recommend my relatives and friends to buy this product | 0.768 | 0.795 | 0.923 | 0.834 |
| | I would love to introduce and recommend this product to my family | 0.789 | 0.751 | 0.909 | 0.752 |
| | I would buy this product if I needed to buy it | 0.852 | 0.822 | 0.912 | 0.881 |

# 4 Experiment 2

The purpose of experiment 2 was to verify whether the mediating effect of perceived green washing in product scarcity appeals on green product purchase intentions holds true.

## 4.1 Experimental design and subjects

A (scarcity group vs. control group) single factor experimental design was used for experiment 2. The same experimental method as in experiment 1 was used, and the stimuli and materials were changed, with "recyclable paper bottles" selected as the stimuli. In this experiment, 104 undergraduates from a university in southern China were used as subjects, and the respondents were divided into a scarcity group and a control group. Samples that did not meet the requirements were excluded, and 100 valid samples were finally retrieved ($M_{age} = 24.88$, $SD_{age} = 3.72$; 52% female). The results of the collected data showed that the scarcity group was 58 and the control group was 42.

## 4.2 Experimental procedures

The experiment began by randomly assigning subjects to the two groups mentioned above, divided into a scarcity group and a control group. Each subject participating in this experiment received a small gift after completing the experimental task independently. We used a role-playing method to have subjects read a self-compiled material in order to manipulate their perceived green washing toward buying green products with scarcity appeals.

This experiment was consistent with experiment 1's manipulation of subjects' perceptions of green product scarcity appeals and used a marketing scenario to initiate subjects' perceived green washing. After reading the material, in order to determine the validity of the experimental material, subjects completed the questionnaire questions used in our adopted study by White and Peloza (2009) and Liu et al. (2017) and measured using a 5-point Likert scale. First, after reading the material, the subjects continued to rate their perceived emotions on a five-point scale (1 = not at all scarce, 5 = very scarce). The subjects also had to answer the questions in the questionnaire regarding the perceived green washing scale and the green product purchase intention scale, and choose the corresponding score for each statement according to the degree of agreement after reading the materials (1 = strongly disagree, 5 = strongly agree).

## 4.3 Results

Experiment 2 first verified whether the main effect of product scarcity appeals on perceived green washing was valid. The respondents of this study were first divided into a scarcity group and a control group, and the results of the collected data showed that there were 52 respondents in the scarcity group and 48 respondents in the control group. The hypotheses were tested by one-way ANOVA. In order to exclude the influence of control variables such as gender, age and education on the experimental results, we added gender, age and education together with product scarcity appeals as independent variables to the model. The results of descriptive statistics showed that respondents in the scarcity group ($M_{scarcity} = 3.307$, $SD_{scarcity} = 0.859$) had a higher mean value of perceived green washing compared to respondents in the control group ($M_{control} = 2.367$, $SD_{control} = 0.878$).

The significance of the corrected model $p = 0.000 < 0.05$ showed that the current model had independent variables that had a significant effect on the dependent variable. The model fit was 0.125, which met the general linear model general criteria and the model fit was good. The results of the between-subjects effect test showed that in the model, there was no significant effect of gender on perceived green washing ($F = 1.287$, $p = 0.26 > 0.05$), no significant effect of age on perceived green washing ($F = 0.351$, $p = 0.555 > 0.05$), and no

significant effect of education on perceived green washing ($F = 1.463$, $p = 0.23 > 0.05$), indicating that none of the control variables had a significant effect on perceived green washing. And product scarcity appeals had a significant effect on perceived green washing ($F = 14.007$, $p = 0.000 < 0.05$).

The second step was taken in order to verify whether the mediating effect of perceived green washing in the product scarcity appeals on the willingness to purchase green products holds true. We used gender, age, and education as control variables, product scarcity as independent variables, perceived green washing as mediating variables, and purchase intention as dependent variables, and analyzed the mediating effect of perceived green washing in product scarcity appeals on green product purchase intention by using the PROCESS program of SPSS macro program developed by Hayes, selecting model 4. And the bootstrap test results were also checked, the confidence interval was 95%, the sample size was chosen to be 5,000, and the sampling method was the non-parametric percentile method with selection bias correction. The output of PROCESS contained two parts: the regression coefficient test results and the bootstrap test results of the indirect effect, and the final mediating effect test results were summarized in Table 2.

As can be seen from Table 2, when perceived green washing was the dependent variable, product scarcity appeals had a significant positive effect on perceived green washing ($B = 0.934$, $t = 5.322$, $p < 0.001$). When purchase intention was the dependent variable, perceived green washing had a significant negative effect on purchase intention ($B = -0.405$, $t = -4.583$, $p < 0.001$) and product scarcity appeals still had a significant negative effect on purchase intention ($B = -0.409$, $t = -2.378$, $p < 0.05$), indicating that perceived green washing had a significant partially mediated effect, product scarcity appeals can either have a negative effect on green product purchase intention directly or through the partially mediated effect of perceived green washing on green product purchase intention.

Further, based on PROCESS, which gave the model test for perceived green washing as an outcome variable, it can be concluded that the $R$-value of the model when perceived green washing was the outcome variable is 0.511, $p < 0.001$, which was statistically significant, and the regression coefficient $B = 0.934$, which had a significant effect ($p < 0.001$), with a 95% CI of (0.186, 0.607) and an interval not containing 0, indicating that product scarcity appeals had a positive correlation on perceived green washing.

Subsequent model testing with purchase intention as the outcome variable yields an $R$-value of 0.610, $p < 0.001$, indicating a statistically significant model when purchase intention was the outcome variable, with regression coefficient $B$ (perceived green washing vs. purchase intention) = −0.405, with a significant effect ($p < 0.001$) and 95% CI of (−0.580, −0.229). Regression coefficient $B$ (product scarcity appeals vs. purchase intention) = −0.409, significant ($p < 0.05$), 95% CI (−0.751, −0.068), interval did not contain 0. Therefore, it can be concluded that perceived green washing had a mediating effect, and perceived green washing was a partial mediating effect.

## 4.4 Discussion

Experiment 2 once again confirmed the relationship between product scarcity appeals and perceived green washing. By initiating subjects' perception of product scarcity, it was tested that the perceived green washing in this scenario was consistent with hypothesis 1 of this paper, i.e., subjects had higher perceived green washing for green products with product scarcity appeals. Hypothesis 2 was tested again in experiment 2, where a question was asked to initiate subjects' perceived green washing to verify the mediating role of perceived green washing between product scarcity appeals of green products and consumers' purchase intentions.

# 5 Experiment 3

The purpose of experiment 3 was to verify that motivation of impression management moderated the mediating role of perceived green washing in product scarcity appeals on green product purchase intentions.

## 5.1 Experimental design and subjects

A (scarcity group vs. control group) single factor experimental design was used for experiment 3. The same experimental method as experiment 1 was used, but the stimuli and materials were changed, and "biodegradable plastic" was selected as the stimulus. In this experiment, 112 undergraduates from a university in southern China

TABLE 2 The mediating effect of perceived green washing.

| Variables | Perceived green washing | | | Purchase intention | | |
|---|---|---|---|---|---|---|
| | *B* | *se* | *t* | *B* | *se* | *t* |
| Constant | 4.970 | 0.447 | 11.111*** | 2.607 | 0.584 | 4.467*** |
| Perceived green washing | | | | −0.405 | 0.088 | −4.583*** |
| Product scarcity appeals | 0.934 | 0.175 | 5.322*** | −0.409 | 0.172 | −2.378* |
| Gender | −0.325 | 0.173 | −1.872 | 0.064 | 0.152 | 0.420 |
| Age | −0.024 | 0.078 | −0.313 | −0.131 | 0.067 | −1.945 |
| Education | −0.064 | 0.063 | −1.011 | −0.011 | 0.054 | −0.199 |
| *R* | 0.511 | | | 0.610 | | |
| *R-sq* | 0.261 | | | 0.372 | | |
| *F* | 8.382*** | | | 11.121*** | | |

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

were used as subjects, and the respondents were divided into a scarcity group and a control group. The subjects who did not fill in the required samples were excluded, and 100 valid samples were finally obtained ($M_{age} = 23.91$, $SD_{age} = 3.29$; 51% female). The results of the collected data showed that the scarcity group was 61 and the control group was 39.

## 5.2 Experimental procedures

The subjects were first randomly assigned to the two groups mentioned above, divided into a scarcity group and a control group. Each subject participating in this experiment received a small gift after completing the experimental task independently. A role-playing approach was used to have the subjects read a self-compiled material to manipulate the effect of motivation of impression management on the purchase of a green product with a product scarcity appeal.

This experiment was consistent with experiment 1's manipulation of subjects' perceptions of green product scarcity appeals and used a marketing scenario to initiate subjects' motivation of impression management. After reading the material, in order to determine the validity of the experimental material, subjects completed the questionnaire questions used in our adopted study by White and Peloza (2009) and Liu et al. (2017) and measured using a 5-point Likert scale. First, after the subjects read the material, they were given a five-point scale for the relevant emotion they felt (1 = not at all scarce, 5 = very scarce). The subjects were then asked to answer questions on the scales of motivation of impression management, perceived green washing, and purchase intentions about green products. The corresponding scores were selected according to the level of agreement after reading the material and the level of agreement with each statement (1 = strongly disagree, 5 = strongly agree).

## 5.3 Results

The results of descriptive statistics showed that respondents in the scarcity group ($M_{scarcity} = 3.111$, $SD_{scarcity} = 1.062$) had higher mean values of motivation of impression management compared to respondents in the control group ($M_{control} = 2.712$, $SD_{control} = 1.054$). Then we used gender, age, and education as control variables, product scarcity appeals as independent variables, motivation of impression management as moderating variables, perceived green washing as mediating variables, and green product purchase intention as dependent variables, and used Model 14 of the PROCESS program of the SPSS macro program developed by Hayes to analyze the effect of perceived green washing in the product scarcity appeals on green product purchase intention. The final results of the moderating effect test were shown in Table 3.

The control variables gender ($B = 0.070$, $t = 0.411$, $p > 0.05$) had no significant effect, age ($B = -0.196$, $t = -2.591$, $p > 0.05$) had no significant effect, and education ($B = 0.003$, $t = 0.054$, $p > 0.05$) had no significant effect on willingness to purchase green products. Perceived green washing had no significant effect on green product purchase intention ($B = 0.382$, $t = 3.655$, $p > 0.05$). Motivation of impression management had no significant effect on green product purchase intention ($B = 0.102$, $t = 1.290$, $p > 0.05$). The effect value of the interaction term of perceived green washing and motivation of impression management on green product purchase intention is 0.079, and the corresponding significance $p < 0.05$ indicated that the interaction term of perceived green washing and motivation of impression management had a significant effect on green product purchase intention, i.e., the moderating effect of motivation of impression management on perceived green washing in product scarcity appeals on green product purchase intention was valid.

Further, when motivation of impression management was at a low level, the negative effect of perceived green washing on green product purchase intention was not significant with a 95% CI of (−0.481, 0.081) and an interval containing 0. When motivation of impression management was at a medium level, the effect of perceived green washing on green product purchase intention changed from negative to positive with $B = 0.045$ and a 95% CI of (0.122, 0.521), and the interval did not contain 0. When motivation of impression management was at a high level, the positive effect of perceived green washing on green product purchase intention was strongest with $B = 1.255$, 95% CI of (0.159, 0.682), and the interval did not contain 0. When motivation of impression management increases by one unit, the effect of product scarcity appeals on green product purchase intention through perceived green washing increased by 0.524 units. Thus, it can be seen that motivation of impression management moderated the effect of perceived green washing on the purchase intention of green products, and when motivation of impression management was at a high level, purchase intention was increased through the moderating effect.

## 5.4 Discussion

Experiment 3 tested that motivation of impression management in this scenario moderated the mediation of perceived green washing in product scarcity appeals on green product purchase intentions by initiating subjects' motivation of impression management, which was consistent with hypothesis 3 of this paper. i.e., when subjects in the scarcity group had higher motivation of impression management compared to the control group, perceived green washing in product scarcity appeals would be lower, thus validating hypothesis 3. Experiment 3 also verified that motivation of impression management moderated the negative effect of product scarcity appeals on green product purchase intention by using questions to initiate subjects' motivation of impression management.

# 6 General discussion

This study examines the fact that when green products express product scarcity appeals, consumers do not necessarily pay for them. In fact, green products are different from common products, and purchasing green products often reflects an individual's pro-sociality, which belongs to designated morality and conforms to the category of morality, with the dual attributes of altruism and self-interest. In the past, studies have mainly explored how ordinary products can be marketed virtually through product scarcity appeals, or even converted into phantom alternatives, but few studies have explored how green products can be marketed virtually. Moreover, because green products have dual attributes, their virtual marketing may not have the same effect on them. On this basis, this study examines the

TABLE 3 The moderating effect of motivation of impression management.

| Variables | Purchase intention | | | | Perceived green washing | | | |
|---|---|---|---|---|---|---|---|---|
| | *β* | *SE* | *t* | *p* | *β* | *SE* | *t* | *p* |
| Constant | 4.108 | 0.431 | 9.521 | 0.000 | 0.707 | 0.424 | 1.669 | 0.098 |
| Product scarcity appeals | −0.524 | 0.191 | −2.740 | 0.044 | 0.805 | 0.167 | 4.814 | 0.000 |
| Motivation of impression management | 0.102 | 0.079 | 1.290 | 0.200 | | | | |
| Gender | 0.070 | 0.170 | 0.411 | 0.682 | 0.367 | 0.163 | 2.252 | 0.067 |
| Age | −0.196 | 0.076 | −2.591 | 0.061 | −0.099 | 0.075 | −1.328 | 0.188 |
| Education | 0.003 | 0.061 | 0.054 | 0.957 | 0.036 | 0.061 | 0.596 | 0.553 |
| Perceived green washing | 0.382 | 0.105 | 3.655 | 0.100 | | | | |
| Perceived green washing * Motivation of impression management | 0.079 | 0.086 | 0.917 | 0.004 | | | | |
| Sample | 100 | | | | 100 | | | |
| *R* | 0.613 | | | | 0.493 | | | |
| $R^2$ | 0.376 | | | | 0.243 | | | |
| *F* | $F = 7.908$, $p = 0.000$ | | | | $F = 7.605$, $p = 0.000$ | | | |

effect of product scarcity appeals on the purchase intention of green products in a green product purchase context, and explores its intrinsic mechanisms and boundaries.

In addition, perception of deceptive increases consumers' green consumption confusion and green perception risk, and affects consumers' trust in green products. Therefore, the level of consumers' perceived green washing affects their green purchase intention; the lower the perceived green washing, the higher the consumers' purchase intention; the higher the perceived green washing, the lower the consumers' purchase intention. Perceived green washing plays a mediating role in the effect of product scarcity appeals on purchase intention. In addition, motivation of impression management is a motivation to show its pro-social individual attributes to others. That is, consumers may perceive purchasing green products as a way to gain status associated with pro-social behavior and to show others that they are pro-social individuals. Consumers' own motivation of impression management may lead them to engage in pro-social altruistic behaviors, such as showing more interdependent self-image in group purchasing scenarios. Therefore, this thesis verifies through research that when consumers' motivation of impression management is high, they will reduce their perceived green washing of green products with product scarcity appeals as a strategy, thus increasing their willingness to purchase such products.

Regarding the results of the experiment, experiment 1 preliminarily verifies that product scarcity appeals have a negative effect on green product purchase intentions. Experiment 2 again verified the inhibitory effect of product scarcity appeals on purchase intentions, and also verified the mediating role of perceived green washing, specifically, products with high scarcity appeals can effectively enhance consumers' perceived green washing compared to products with low scarcity appeals, which in turn reduces consumers' green product purchase intentions. Experiment 3 found that the moderating effect of motivation of impression management on perceived green washing in product scarcity appeals on green product purchase intentions, when products with scarcity appeals have high consumer motivation of impression management, consumers' perceived green washing on product scarcity appeals will be reduced and they will have positive purchase intentions for green products.

## 6.1 Theoretical implications

First, this study extends the research on product scarcity appeals of green products. Product scarcity appeals are often found in virtual products, where consumers perceive greater risk due to the vague product concept and lack of physical presence, and are thus more likely to produce perceived green washing in certain contexts (Li D.J. et al., 2015; Li D.Y. et al., 2015; Liu et al., 2017). Product scarcity appeals are an important concept in virtual marketing, and previous studies have focused on the impact of product scarcity appeals on ordinary product purchase intentions, and less on the effect of product scarcity appeals in green product purchase contexts; in fact, green products are different from ordinary products, and the purchase of green products often reflects the pro-sociality of individuals, which is in line with the moral category and has the dual attributes of altruism and self-interest. Past research has focused on how ordinary products can be marketed in a false sense through product scarcity appeals, or even transformed into phantom alternatives, i.e., "products that are not available at the time of purchase" (Young et al., 2010). However, few studies have explored how phantom marketing is conducted for green products, which are different from ordinary products in that they have dual attributes, i.e., pro-social moral attributes and self-interest utility attributes, and their phantom marketing may have different effects on them. This study explores the impact of product scarcity appeals on the purchase intention of green products in the context of green product purchase, and explores the intrinsic mechanisms and boundaries.

Second, this study extends the findings of previous studies on perceived green washing on green product purchase intentions. It has been confirmed that in Chen and Chang (2013) found that deceptiveness increases consumer confusion about green consumption

and perceived risk of greenness, affecting consumer trust in green products. Therefore, the level of consumers' perceived green washing affects their green purchase intentions; the lower the perceived green washing, the higher the consumers' purchase intentions; the higher the perceived green washing, the lower the consumers' purchase intentions. Therefore, if green products are promoted using the product scarcity appeal, consumers may easily perceive this promotion as a strategy for companies to promote themselves as green to gain social reputation, rather than really wanting to produce green products, because these products are "scarce" or even high-priced, and consumers may think that companies are not going to produce large quantities of these products for environmental improvement, and thus consumers may have a perceived green washing, which affects their willingness to buy the products.

Third, this study has several implications in terms of exploring the mechanism of the role of consumer motivation of impression management on the purchase intention of green products. Motivation of impression management is a motivation to demonstrate to others that they are pro-social individuals. That is, consumers perceive purchasing green products as a way to gain status associated with prosocial behavior and to demonstrate to others that they are prosocial individuals. In fact, motivation of impression management is present in every individual, but the strength of motivation of impression management is not consistent for different individuals. It has been suggested that when people are able to leave a positive self-image to others when they engage in pro-social behaviors, then this impression management motivation motivates consumers to engage in more pro-social behaviors (Wu, 2014). The interdependent self, which views oneself as a member of a social relationship and emphasizes the importance of an individual's relationship with others and the interdependence of both, is a completely different self-concept from the independent self (Abele et al., 2021). In studies on social interaction aspects, motivation of impression management motivates people to try to change the impression they form in the minds of others; consumers' own motivation of impression management motivates them to engage in pro-social altruistic behaviors, for example, in group buying scenarios, consumers will show more interdependent self-image (Bolino et al., 2008). Therefore, this thesis verifies through research that when consumers' motivation of impression management is high, they will reduce their perceived green washing toward green products that use product scarcity appeals as a strategy, thus increasing their willingness to purchase such products.

## 6.2 Managerial implications

First, this study provides a theoretical basis for companies to avoid the negative effects of advertising when promoting green products. Advertising is the most direct and effective promotional tool used by companies to promote green products or services, and it can significantly influence consumers' attitudes and behaviors toward such products. In addition to making advertising promotional, attention needs to be paid to avoiding negative effects of advertising, which is not only an evergreen topic in advertising and consumer behavior, but also a problem that needs to be solved by companies in general. This study finds that product scarcity appeals can make consumers easily perceive deceptive advertising messages and reduce their willingness to buy, which also applies to green product consumption. Therefore, companies should avoid monotonously and emphatically expressing product scarcity appeals in advertisements promoting green products, and instead promote the unique environmental attributes of green products to enhance consumers' willingness to purchase green products.

Second, companies should highlight "green" rather than "green washing" when using the green product logo. The study found that for consumers who are highly concerned about environmental issues, the more familiar they are with the brand, the higher their enthusiasm for consumption if the product has a green certification logo; however, when the product packaging does not have an eco-label, brand familiarity has no significant impact on purchase intentions, but consumers will have perceived green washing, thus reducing the desire to buy the product. For consumers who are less concerned about environmental issues, when products with green logos and other content that can reflect their environmental characteristics, consumers will change their inner discriminatory results about their quality and green washing behavior to the point of weakening their own impulse to consume. Therefore, when companies try to use logos to prove that their products are "green," they should also convey information about the quality of their products to consumers.

Third, this study finds that motivation of impression management can play an important moderating role when firms promote green products using scarcity appeals. Specifically, for consumers with high motivation of impression management, consuming green products will make them feel that their moral image is improved, and thus they tend to prefer green products that are promoted using scarcity appeals. Therefore, when using product scarcity appeals, companies should design different advertising contents according to the consumer portrait and different advertising audiences, so that consumers with high motivation of impression management can experience the product scarcity appeals expressed in the advertising, thus achieving the marketing effect that companies want.

## 6.3 Limitations and future research

In terms of study limitations. Firstly, the experimental subjects who participated in this study were mainly undergraduate and graduate students in a university. Therefore, the subjects were relatively homogeneous in terms of education, age and education level, and the purchase of green products occurred in different groups. Therefore, in future studies, the scope of subjects can be further extended to different consumer groups to improve the generalizability and practicability of the findings of this study. Secondly, this study investigates how product scarcity appeals of green products affect consumers' purchase intentions in the context of green marketing communication, and what are the potential mechanisms and boundary conditions involved. There are many types of product scarcity appeals, such as supply and demand product scarcity appeals, limited and time-limited product scarcity appeals, environmental and human product scarcity appeals, explicit and implicit product scarcity appeals, and so on. Therefore, the research products in this paper are relatively limited. Lastly, the moderating effect in this paper also only detects motivation of impression management, while in fact many factors such as product, information, personality, and context may have moderating effects, and this paper does not test for multivariate moderating effects. The use of experimental quantitative research

methods in this paper is the best way to manipulate the variables and test the causal relationship between the independent and dependent variables. Although this paper uses different experimental goods and contexts for the study, the effects of product scarcity appeals are very broad compared to the proposed model in the paper. For example, the different scarcity effects caused by the situation where the supply of the good does not change on the supply side and the situation where the product cannot meet the market demand can have different effects on consumers' value judgments and purchase intentions. Therefore, the impact of two different scarcity causes and scarcity types on consumers' willingness to purchase green products can be further investigated in depth.

In terms of future research directions. Although this paper combines qualitative and quantitative mixed methods, due to the inadequacy of the research method, different methods are needed to further enhance the reliability and validity of the study in future studies. First is to strengthen qualitative research. In reviewing previous research literature, it was found that there is a serious lack of qualitative research on product scarcity appeals. This therefore greatly limits the impact of explored product scarcity appeals, which can also affect the discovery of new perspectives and mechanisms, as well as limit the expansion of theoretical constructs and marketing practices. Therefore, future research is needed to reinforce the existing research on the impact of product scarcity appeals using, for example, rooting theory, focus interviews, and phenomenological observation. Different qualitative research methods should be utilized to explore the potential influencing mechanisms in a deeper and more comprehensive way. The second is the full use of advanced methods and techniques. With the development, advanced methods and techniques are widely used in many studies, such as implicit attitude measurement, neural network techniques, etc. It has been confirmed from practice that the research findings obtained by using such research methods are scientifically rich. Therefore, in further research in the future, advanced methods and techniques, such as eye-tracking and big data mining, should be fully used to obtain more credible and valid research findings. Third, improve the traditional research methods. The review reveals that the current research on product scarcity appeals is still mainly based on traditional experimental research methods. The traditional methods can be further enhanced and improved in future studies, such as expanding the product range, simulating consumption situations, enhancing the experimental sample size and cross-cultural studies to improve the existing data collection methods. It is believed that changes in traditional experimental methods can improve the external validity of research models and findings.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of the School of Management, Jinan University, China. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

## Author contributions

SY: Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing. GL: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing, Validation, Supervision. YL: Formal analysis, Investigation, Validation, Visualization, Writing – original draft, Writing – review & editing. ZL: Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. YS: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. ZH: Conceptualization, Methodology, Project administration, Supervision, Writing – review & editing, Validation.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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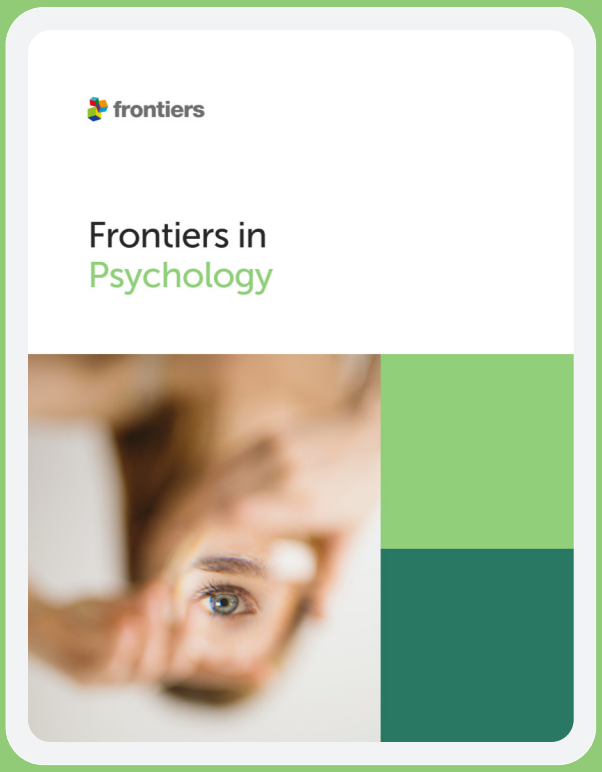


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