



OPEN The “label code” of pro-environmental behavior—a study on pro-environmental behavior based on behavioral label theory

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The topic of environmental protection has received more and more attention, among which pro-environmental behavior is a major focus of attention. Based on the findings of construal level theory, behavioral labels, and personal norms, combined with the principles of mental imagery, this study explored how behavioral labels affect consumers' pro-environmental behavior through three experiments, and analyzed the mechanism of construal level, personal norms and mental imagery. The study found that pro-environmental behavior labeling can effectively promote consumers to implement corresponding behaviors, and verifies the applicability of behavior labeling theory in this field. Mediating mechanism analysis showed that mental imagery and personal norms mediated the relationship, while construal level moderated the effect of behavioral labels on personal norms. Different from the positive moderating effect of conventional cognition, it was found that the construal level played a negative moderating role in the related mechanism. The study reveals the enhancement effect of behavioral labeling in pro-environmental behavior and its boundary conditions, which provides new inspiration for the expansion of related theories and practical application.

Keywords Behavioral labels, Construal level, Mental imagery, Pro-environmental behaviors, Personal norms

In recent years, global environmental pollution issues have become increasingly severe, with plastic pollution standing out particularly¹. According to the research by Lau et al., plastic pollution has become a global threat, with previous studies estimating that approximately 8 million tons of large plastic and 1.5 million tons of primary microplastics enter the oceans annually. If plastic production and waste generation continue to grow at the current rate, it is expected that the annual quality of poorly managed waste will more than double by 2050². Additionally, air quality remains at low levels in many regions around the world. According to the recent 2024 Global Air Quality Report released by IQAir, only 17% of cities worldwide meet the WHO air quality guidelines. Data from 138 countries and regions participating in air quality analysis show that 126 of them (91.3%) exceeded the World Health Organization's guideline value of 5 micrograms per cubic meter for annual average PM2.5, indicating that global air pollution remains a pressing issue that needs to be addressed³. These phenomena underscore the complexity and urgency of global environmental pollution, and the urgent need for concerted action by the international community to promote the implementation of sustainable solutions.

Therefore, environmental protection has gradually become a topic of extensive concern among scholars, policy makers and business managers around the world. He et al. explores whether China's two-way FDI coordination can enhance GTFP, highlighting the significance of this coordination in China's green economic development⁴. Zhou et al. focus on how China's CETPP impacts corporate ESG performance, showing how policy can drive corporate environmental protection behaviors⁵. Zhang et al. study the institutional configuration for urban green economic efficiency, emphasizing the need for a transition to a green economic model to address environmental challenges⁶. Such articles contribute from different perspectives to the understanding of the relationship between a country's investment, policies, institutional arrangements, and environmental protection in pursuing the Sustainable Development Goals.

In addition, it is also important to develop the theory of pro-environmental behavior related to consumers to provide guidance. Existing studies have shown that the formation of pro-environmental behaviors is influenced by multiple factors, including psychological factors, social and cultural factors, and external environmental

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conditions^{7,8}. Specifically, individual pro-environmental behavior is influenced by factors including but not limited to personal characteristics, social norms, values, emotional attitudes, environmental knowledge, and external incentives. Personal characteristics, such as personality traits, education level, and economic status, are widely considered to be important factors influencing pro-environmental behavior^{9–11}. In addition, normative factors such as personal norms and social norms (i.e., the patterns and standards of behavior generally accepted in society) have a strong constraining and guiding effect on individual behavioral decisions^{12,13}. On the other hand, external incentives, such as economic rewards or policy incentives, have also been shown to play a crucial role in promoting pro-environmental behaviors¹⁴.

Related studies have shown that artificial intelligence also affects consumers' sustainable behaviors. The research results of Popa R-G et al. indicated significant links between the evolution of AI, online engagement, and the trust placed in sustainability-related feedback among youth populations¹⁵. Cao P et al. found that AI technology stimuli indirectly promote sustainable consumption behavior through customer-perceived value and customer stickiness¹⁶. Additionally, AI-generated content can shape children's pro-environmental attitudes and behaviors¹⁷. These studies demonstrate that online methods can also effectively promote consumers' pro-environmental behaviors.

Scholars have also explored the relationship between labels and consumers' pro-environmental behaviors.

Existing research generally focuses on how products labeled with environmental labels affect consumers' pro-environmental behavior, as shown by the research of Težak Damijanić A et al., which indicates that environmental labels influence pro-environmental behavior¹⁸. Additionally, there are studies on emotional labels suggesting that negative emotional labels can enhance environmental self-identity, thereby affecting corresponding pro-environmental behavior¹⁹. As for behavioral labels, related research is still relatively limited. Fritze et al.'s experiments also showed that providing a behavioral label description "drinking beverages with takeaway cups without using plastic cup lids" more strongly prevented the use of plastic cup lids with takeaway cups, and that the experiments observed significant differences in preventing the use of plastic cup lids between the label conditions and the no label conditions²⁰. This indicates that labeling behavior may promote corresponding pro-environmental behavior.

Despite in-depth explorations of multiple antecedents of pro-environmental behavior in existing studies and significant achievements in academia, there are still some limitations in the current research on pro-environmental behavior. Firstly, existing literature primarily focuses on consumer pro-environmental behaviors with preconditions such as individual emotional and characteristic details or macro-level variables in social environments^{9–11}, but although there have been studies on behavioral label and pro-environmental behaviors, more experimental support is needed to establish their general applicability and extensibility in consumer contexts. Secondly, although existing research has proposed that mental imagery mediates the effect of behavioral labels on behavior²⁰, there is also a lack of theoretical support for whether other factors play a mediating role; Finally, existing studies mostly explore the regulatory effects on pro-environmental behaviors from various angles such as natural affinity, environmental literacy, social distance, social norms, and moral identity in different contexts^{21–25}, but they pay less attention to the influence from the perspective of the explanation level theory. Although there have been some studies exploring the moderating role of construal levels in contexts related to pro-environmental behaviors²⁶, there is still a lack of research on the moderating role of construal levels combined with behavioral labels. If the above-mentioned issues can be clarified, not only will it advance the application research of behavioral labels in pro-environmental behavior fields, but it will also enrich the theoretical framework of pro-environmental behavior antecedents, providing new theoretical references for understanding their internal mechanisms. It will also expand the research on the role of language expression in pro-environmental behavior fields, answering our questions about this interdisciplinary intersection.

Based on these aspects, our study explores the influence mechanism of behavioral labels on pro-environmental behavior through experimental research, combining theories of personal norms, mental imagery, and construal level theory to construct an integrated theoretical model. The model assumes that behavioral labels enhance an individual's level of mental imagery by activating their personal norms, thereby promoting pro-environmental behavioral intentions, and further explores the moderating role of construal level in this process. To validate this model, our study combined experimental design and questionnaire surveys to collect consumer data from different IPs and conducted empirical tests using methods such as analysis of variance and regression analysis. The results of the study confirmed our assumptions about the relationship between behavioral labels and mental imagery, and differ from the intuitive understanding of construal levels in text comprehension. The study found that construal levels have a negative regulatory effect rather than a positive one on the impact of pro-environmental behavioral labels on personal norms.

The main theoretical contributions of the study are as follows: First, unlike existing literature that explores pro-environmental behaviors from the perspective of specific individuals or groups such as farmers or corporate employees^{22,27}, or from a general perspective on personal characteristics, norms, and external incentives^{9–14}, we focus on consumer consumption behavior. We examined the influence of pro-environmental behavior from a unique perspective of using "behavioral labels" to describe pro-environmental behaviors in consumption contexts. Research also examined the specific mediating and moderating mechanisms of relevant variables on pro-environmental behavior in consumption scenarios based on the findings related to mental level theory and personal norms. This has to some extent supplemented the theoretical perspectives on consumers' pro-environmental behavior in linguistic contexts and provided new theoretical explanations for the mechanisms linking behavioral labels with pro-environmental behavior. Next, studies have demonstrated a significant correlation between personal norms and mental imagery. Personal norms can positively influence consumers' mental imagery, providing new insights for research on pro-environmental behaviors related to mental imagery. The study results also further advance the relationship between mental imagery and personal norms, offering another research perspective for the study of post-factors of personal norms. Finally, our research found that

the construal level has a moderating effect on the aforementioned mechanisms, and we discuss the moderating role of the level of explanation as a variable in different contexts on the relationship between behavioral labels and personal norms. The study discovered that, contrary to the conventional belief that construal level has a positive effect on the process of behavioral labels affecting personal norms, in the context of this study, it actually plays a negative moderating role, providing some thoughts for future related explorations. In addition, the research conclusions also provide important references for corporate marketing management, the formulation of government environmental protection policies, environmental education, environmental publicity, and the organization of charitable institutions.

Study theories and hypotheses

Behavioral labels and pro-environmental behaviors

In linguistics research, the dynamic association between language and human behavior has always been a key topic of theoretical discussion. The research foundation in this field can be traced back to the Sapir-Whorf hypothesis, which emphasizes the decisive role of the native language system in shaping an individual's worldview. The core viewpoint of this hypothesis lies in the idea that language systems not only serve as carriers of thought but also profoundly influence the construction of cognitive patterns through grammatical structures and vocabulary systems. This cognitive framework shaping process has a bidirectional characteristic—both influenced by existing ways of thinking and reciprocally affecting subsequent cognitive development and behavioral choices²⁸.

Existing research defines pro-environmental behavior (PEB) as an individual's positive actions towards the environment, with the intent to use environmentally friendly products^{29,30}. These behaviors include conserving resources, green travel, and waste recycling, etc.^{7,8}. Scholars classify pro-environmental behaviors into actions in the public domain and those in the private domain³¹, studying the influence mechanisms of various factors on these two types of behaviors, thereby enriching the related theories of pro-environmental behavior. In existing research, scholars refer to the practice of using a name or label to reflect a related activity as the “behavioral labels” phenomenon. Existing studies show that when consumers find their behaviors labeled, they adjust their self-perception in any way (not just when a new term is invented for the behavior), and subsequently, they start to act according to the label. For example, the “up-smiling” label can encourage students to use more smile emojis in online courses²⁰. These findings demonstrate the impact of social labels (i.e., labels assigned to a person) on individual behavior, and in most cases, behavior labels can enhance the implementation of behavior.

Specific pro-environmental behaviors vary widely, and labeling pro-environmental behaviors is also a form of labeling individual behaviors, among which there should exist mechanisms similar to those discovered by existing researchers. Fritze et al.'s experiments also showed that providing a behavioral label description “drinking beverages with takeaway cups without using plastic cup lids” more strongly prevented the use of plastic cup lids with takeaway cups, and that the experiments observed significant differences in preventing the use of plastic cup lids between the label conditions and the no label conditions²⁰. This experiment of their research also to some extent involves pro-environmental behavior, indicating that there is a certain connection between language and behavior, and there is also a certain association between behavior labels and pro-environmental behavior. This connection might be consistent with the results of previous studies, i.e., we believe that compared to general scenario descriptions, if behavior labels related to pro-environmental behaviors involved in the scenario are used, it would make consumers more willing to implement pro-environmental behaviors later. Based on the above theories, we propose the following hypotheses:

H1: Pro-environmental behavior labels can promote the implementation of corresponding pro-environmental behaviors.

The mediating role of personal norms and mental imagery

Behavioral labels and personal norms

Personal norms are a sense of moral obligation towards a behavior, which can increase or decrease the tendency to perform that behavior³². In terms of behavioral labeling and personal norms, existing research shows that word labels can establish a psychological connection between the label and the labeled entity³³. A study found that individuals were more likely to comply with the norms of non-littering in a state of physiological arousal after reading material that was closely related to anti-littering norms³⁴. This suggests that norm-related written material is able to influence behavior by activating personal norms by enhancing physiological arousal. Behavioral labels are interpreted by consumers, triggering relevant experiences that resonate with the corresponding tags, thereby activating and reinforcing personal norms about how we interact with our surroundings.

Van Riper and Kyle combine VBN theory with values and beliefs, pointing out that pro-environmental behavior depends on a sense of moral obligation, that is, personal norms³⁵. From an eco-marketing perspective, scholars have observed that environmental behaviors are converging in terms of personal moral obligations. Existing research provides multiple pieces of evidence indicating that activated personal norms determine individual pro-environmental behaviors. Existing studies have shown that PGPBs (perceived green psychological benefits) of customers in green hotels have a significant positive impact on customers' GPV (perceived green value), self-efficacy beliefs, personal norms, and pro-environmental behavior. Self-efficacy beliefs influence personal norms, while personal norms are not affected by GPV³⁶.

Existing literature also supports the predictive role of personal norms on pro-environmental behavior. Studies have found a strong positive correlation between personal norms and PEB, as in the research by De Groot et al.^{37–39}. In other words, the stronger an individual's personal norms regarding a specific PEB, the stronger their intentions and behaviors related to that PEB.

Personal norms and mental imagery

Personal norms and mental imagery play important roles in individual behavior regulation and moral decision-making. Personal norms are a sense of moral obligation regarding a behavior that increases or decreases the likelihood of performing that behavior³². These norms play an important role in individuals' daily lives, influencing their behavior choices, decision-making processes, and self-regulation abilities. Mental imagery refers to the image-like representation that an individual forms in their mind after being stimulated by external stimuli, including three core dimensions: vividness (the intensity, clarity, or uniqueness of the image in the individual's mind), quantity (the number of images that appear in the individual's mind), and valence (the emotional association the individual attaches to a specific memory)⁴⁰. Mental imagery as part of the cognitive process not only help individuals simulate situations before behavioral execution but also evoke emotional responses and influence behavioral decisions. Existing studies have shown that the activation degree of personal mental imagery varies with different scenarios, such as Cowan et al.'s research finding that VR shopping scenarios can evoke a sense of presence, thereby positively influencing consumers' mental imagery, brand attitude, and purchase intention⁴¹. Some studies also suggest that personal norms can have an impact on the formation of mental images, thereby influencing the execution of individual behavior.

According to the two-stage model of goal setting and goal pursuit proposed by Bagozzi and Dholakia (1999), the human decision-making process typically begins with a vague intention or orientation, followed by the mobilization of specific cognitive resources to simulate the execution details⁴². Personal norms are precisely this initial intention and moral orientation, which triggers thoughts about the outcomes of behavior, and mental imagery is a vivid form that may be used in these thoughts, serving as the motivational foundation provided by personal norms and the cognitive simulation and emotional stimulation provided by mental imagery. In behavioral decision-making, personal norms act as deep, stable moral motivations that provide the initial willingness and rationale for behavior¹², while mental imagery plays a role by vividly "rehearsing" the process and outcomes of behavior^{43,44}.

Existing research suggests that when behaviors are not pro-environmental, individuals who expect to feel stronger guilt are also likely to perceive pro-environmental options as more feasible, and to associate more positive personal outcomes with choosing pro-environmental options, indicating that personal norms (such as moral norms, social norms, and guilt) influence behavioral intentions and actual behavior by guiding the imagination of behavioral consequences⁹. Research shows that children spontaneously generate guilt-related consequence imagination when they violate moral norms, thereby affecting their subsequent behavior⁴⁵. Therefore, we suggest that when an individual internalizes a behavioral norm, relevant mental images (such as the context of successfully performing the norm and the visual representation of its consequences) can spontaneously influence their behavior when the norm is activated.

In summary, there is a close interaction between personal norms and mental imagery. Personal norms help individuals maintain norm-consistent behaviors during decision-making and behavior execution by stimulating relevant mental imagery. This process involves not only the observance of ethical and social norms, but also self-regulation and the achievement of behavioral goals.

Mental imagery and behavior

According to the principle of psychological imagery, and the exploration by Fritze et al. on the mediating effect of behavioral labels on behavior²⁰, we further investigate and validate this mediator in the context of pro-environmental behavior. Studies have shown that mental imagery enhances the interpretation and processing of information by constructing "mental images," allowing consumers to view an object from a new perspective⁴⁶. Similarly, in marketing, mental imagery has been shown to enhance consumers' attitudes towards products or services, allowing them to mentally simulate the use of the product. More importantly, psychological imagery may also influence behavior. Specifically, mental imagery generates quasi-imaginal representations, promoting the generation, interpretation, and formulation of information through spatial representation. First, it can generate new associations and responses to stimuli⁴⁷. Secondly, mental imagery allows consumers to visualize their actions. Consistently, neuroscience research shows that mental imagery manifests in both visual and motor aspects of humans⁴⁸.

In the research by Fritze et al., to some extent, it has shown that mental imagery provides a pathway for understanding behavioral labels, offering a reasonable explanation for their impact on subsequent behavior: behavioral labels evoke mental imagery of the corresponding behavior, thereby increasing the likelihood of its implementation²⁰.

H2: Behavioral labels can stimulate personal norms, which in turn influence corresponding mental imagery and promote pro-environmental behaviors. In other words, personal norms and the mental imagery chain mediate the effect of behavioral labels on pro-environmental behaviors.

The moderating effect of construal level

Trope and Liberman's CLT proposes that psychological distance affects an individual's construal level when perceiving things. Specifically, psychological distance refers to a subjective perception of the distance from other things, with reference to oneself at the time and place, including four dimensions: time, space, social, and hypothetical; construal level refers to the degree of abstraction at which an individual perceives things. For example, regarding an individual's behavior, the question of why they "did it" belongs to a higher level of abstract construal, while "how they did it" belongs to a lower level of concrete construal⁴⁹.

The temporal construal theory suggests that people often have higher levels of psychological construction in the distant future compared to the near future, such as using more abstract features to describe events. Additionally, the theory indicates that values associated with low-level constructions will depreciate over time, while those associated with high-level constructions will appreciate⁵⁰.

Research in the fields of marketing and consumer behavior regarding construal levels is relatively well-developed. Cai Junwu et al. found that when consumers use high-level construal, they focus more on the abstract features and core values of the brand, whereas consumers using low-level construal focus more on specific product attributes and functions⁵¹. Tang Xiaofei et al.'s research also indicates that the construal level plays a crucial moderating role in the relationship between price promotions and brand loyalty. Consumers with a high level of construal are less affected by price promotions because they place more emphasis on the long-term value of the brand⁵².

Existing research, when applying the NAT to explain the willingness for a series of pro-social and pro-environmental behaviors, has found that the relationship between consequence awareness, responsibility attribution, personal norms, and behavioral intentions forms a chain mediation model, that is, consequence perception activates personal norms through responsibility attribution, and individual norms then lead to the occurrence of pro-social and pro-environmental intentions⁵³.

In the relationship between personal norms and behavioral labels, people with high and low levels of construal style often have different understandings when facing highly general and abstract behavioral labels. We believe that this abstraction and concreteness difference plays a regulatory role.

High-construal-level consumers typically understand things from a macro, general, and essential perspective, focusing on the reasons, purposes, and values behind things. Therefore, when interpreting pro-environmental behavior labels, they may pay attention to the broader environmental significance represented by these labels, such as their support for higher-level goals like sustainable development, environmental protection, and social responsibility. Such consumers may view this behavior as a positive contribution to environmental protection and consider it from a moral and duty perspective, perceiving the corresponding consequences more strongly. Their corresponding personal norms (sense of moral obligation regarding behavior) are therefore more easily awakened, viewing related pro-environmental behaviors as responsible and moral choices. Consequently, their intention to act may be strengthened, with a higher willingness to perform related pro-environmental behaviors.

For consumers with low interpretive levels, more attention is paid to specific, detailed, and operational aspects. When interpreting pro-environmental behavior labels, they may focus more on the direct effects of the behavior, such as the specific appearance, price, and comfort related to the behavior, and less on its underlying moral significance or environmental impact. Due to a lack of deep understanding of the environmental significance behind the behavior, the consequence awareness of those with lower explanatory levels is weaker compared to people with high explanatory levels. The personal norms of low construal level consumers may not be strongly awakened, and they may view pro-environmental behaviors as simple choices rather than actions based on moral obligations. Therefore, their intentions to act may weaken.

Therefore, we assume that, in the context of pro-environmental behavior labels, the construal level can influence the effect of pro-environmental behavior labels on personal norms, thereby affecting the size of psychological intention, and consequently regulating the level of consumers' pro-environmental behavior implementation. And the following hypotheses are proposed:

H3: Construal level moderates the effect of pro-environmental behavioral labels on personal norms. That is, the higher the level of explanation, the greater the promotion effect of pro-environmental behavior labels on personal norms, and vice versa.

Theoretical model

This study is based on the theory of construal level and relevant principles of personal norms, as well as existing research findings on mental imagery and behavioral labels, and constructs a theoretical model containing a chain mediation and moderation.

We propose that four variables influence the size of the pro-environmental behavior variable, namely: pro-environmental behavior labels, personal norms, mental imagery, and construal levels. Among these, consumers' personal norms and mental imagery mediate the main effect of behavior labels on pro-environmental behavior. Construal levels act as a moderator regulating the effect of personal norms on pro-environmental behavior.

Core variables

Existing research defines the core variables involved in the model mainly as follows: Behavioral labels, which refer to using a name or label to reflect a related activity as "behavioral labels"²⁰; Personal norms, which are a sense of moral obligation regarding a behavior that increases or decreases the likelihood of performing that behavior³². Mental imagery, which is a cognitive form of enhancing information interpretation and processing through the construction of "mental images," allowing consumers to view objects from new perspectives⁴⁶. Pro-environmental behavior, which refers to positive actions individuals take towards the environment, with the intent to use eco-friendly products, including actions such as conserving resources, green travel, and waste recycling⁴⁹. By combining these variable definitions and existing research results, we have constructed the core content of the model.

Core content of model

First, the main path is the primary focus, where research based on behavioral label theory constructs the main effect relationship. According to the established path that behavioral labels enhance behavior, we believe that in consumption contexts, pro-environmental behavior labels also have a similar effect on consumers' pro-environmental behaviors, i.e., the presence of pro-environmental behavior labels can significantly enhance the implementation of corresponding pro-environmental behaviors (Fig. 1).

H1: Pro-environmental behavior labels can promote the implementation of corresponding pro-environmental behaviors.

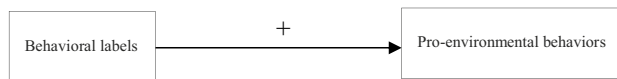


Fig. 1. The path expression of hypothesis 1.

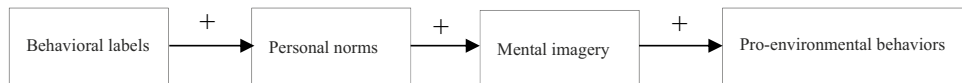


Fig. 2. The path expression of hypothesis 2.

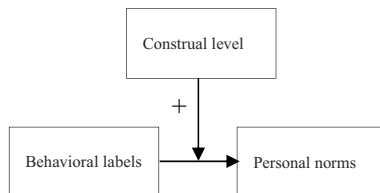


Fig. 3. The path expression of hypothesis 3.

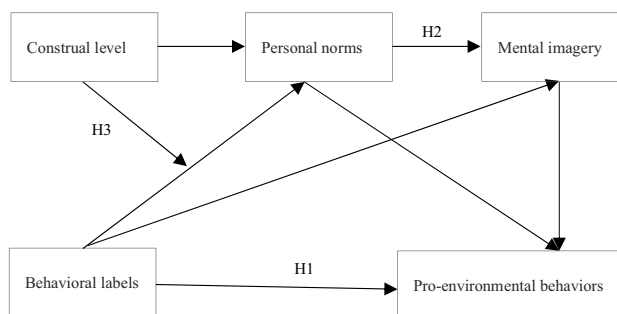


Fig. 4. Theoretical framework model constructed based on theoretical foundations.

Next is the construction of the intermediary pathway. The research constructs the intermediary pathway based on the theory of norm activation and the theory of mental imagery, where behavioral labels influence personal norms in a positive direction in consumption scenarios, which in turn affect corresponding mental imagery, thereby influencing pro-environmental behavior. That is, the chain mediation of personal norms and mental imagery on the effect of behavioral labels on pro-environmental behavior, and constructs the following sequential influence intermediary pathway (Fig. 2).

H2: Behavioral labels can stimulate personal norms, which in turn influence corresponding mental imagery and promote pro-environmental behaviors. In other words, personal norms and the mental imagery chain mediate the effect of behavioral labels on pro-environmental behaviors.

Finally, we construct the moderating effect relationship based on the CLT. Generally speaking, previous studies have shown that construal level has a certain moderating effect on the mechanism of pro-environmental behavior label acting on pro-environmental behavior. In the mediation path constructed based on the theory, construal level has a positive moderating effect on the path of behavior label acting on personal norms, that is, construal level regulates the influence of behavior label acting on personal norms in the mediation path (Fig. 3).

H3: Construal level moderates the effect of pro-environmental behavioral labels on personal norms. That is, the higher the level of explanation, the greater the promotion effect of pro-environmental behavior labels on personal norms, and vice versa.

In summary, we propose that behavioral labels can influence pro-environmental behavior and achieve their effect on pro-environmental behavior through the path of influencing personal norms. Construal level regulates the effect of behavioral labels on personal norms to play a role in this mechanism. This study integrates the above content to derive the theoretical model framework shown in (Fig. 4).

Study method and findings

Study 1

We collected data through a questionnaire, primarily to test H1, using a between-subjects design with one factor (independent variable: behavior description – label vs. no label), with the dependent variable being the willingness to engage in pro-environmental behavior. The experimental context was set in the scenario of choosing eco-friendly accommodation for a trip.

Procedure

The first part of the questionnaire involves label manipulation. The design of the labels is based on the experimental design by Fritze et al.²⁰, we select an environmentally friendly accommodation scenario and label the pro-environmental behavior of choosing to stay at a green hotel as the term “ecological check-in.”

We randomly assign questionnaire participants to two experimental groups. The questionnaire begins by explaining the purpose of the survey. Next, we ask the participants to carefully read the text materials related to label manipulation. Both groups are reminded of the importance of carefully reading the content and answering questions seriously before starting to read the materials. The text material for the no label condition describes: “When planning a travel trip, you face a choice: to book a traditional hotel or choose a green hotel. Traditional hotels may offer more familiar facilities and services, but they may not have specific sustainable measures in terms of energy use, waste management, and overall environmental impact. On the other hand, green hotels focus on reducing their environmental impact by implementing energy-saving and emission-reducing measures, such as using renewable energy, implementing waste sorting and recycling, and providing organic and locally produced food. However, green hotels may be slightly more expensive than traditional hotels because of the additional investments in construction and operation.” The material for the no labeled condition adds label related content at the end, stating: “Here, we describe the act of choosing to stay at a green hotel during a travel trip as ‘ecological check-in.’”

After reading the material, the participants answer questions related to behavioral labels, requiring them to indicate the extent to which they believe the text contains specific expressions describing behaviors (1 = “definitely no,” and 7 = “definitely yes”). This is used to verify whether the label manipulation was successful. Following the design of Fritze et al.²⁰, the questions are set up as: How much do you think the specific expressions describing the act of choosing to stay at a green hotel during travel are contained in the material text? To prevent participants from not understanding the meaning of “specific expression,” the experiment provides an annotation: Here, specific expressions refer to concise words or phrases describing the content.

The second part measures pro-environmental behavior. To ensure that the adapted scale is also highly applicable to the scenario of this experiment, we use a four-item scale adapted from Mukul Dev Surira et al.⁵⁴ to collect data on the pro-environmental behavior variable from the participants. Scales also involve hotel-related contexts and environmentally friendly behaviors in their research. We adapted the scale based on experimental background to collect data on the variable of pro-environmental behavior. The scale uses seven-point Likert scale, with 1 = “Strongly Disagree” and 7 = “Strongly Agree.” Based on the experimental background, the scale is designed with items such as “(1) I have the intention to stay in green hotels when traveling.” (See Supplementary Table S1.). At the same time, the questionnaire includes automatic rejection questions to exclude participants who do not answer seriously or are machine-generated.

Demographic variables are often correlated with pro-environmental behavior in social science research. Without control, it may lead to omitted variable bias, causing the effect of the independent variable to be overestimated or underestimated. Therefore, we also collected the demographic information of the subjects, including gender, age, occupation, and education level, as control variables for the analysis^{9,55}.

Results

The final experiment obtained 99 valid data sets, with 74 female samples and 25 male samples, and an average age of 31 years for the overall sample. In the reliability statistics of the questionnaire, the overall Cronbach's Alpha value was 0.817, indicating good reliability. Our study used confirmatory factor analysis (CFA) to evaluate validity. The analysis results showed that the model fit indices were good ($\chi^2/df=0.793$, GFI=0.992, CFI=1.002, RMSEA=0), indicating that the model fit the data very well. In terms of convergent validity, the average variance extracted (AVE) for the pro-environmental behavior construct was 0.622, and the composite reliability (CR) was 0.867, both above the recommended minimum standards (AVE>0.50, CR>0.60), and all standardized factor loadings were greater than 0.6, with some reaching 0.846, supporting its internal consistency. The square root of the AVE for pro-environmental behavior was high (0.789), and the behavior label variable had only one measurement item, which was used as a manifest variable in the analysis. And exploratory factor analysis showed that this variable formed a factor alone (loading value=0.990) when used as a latent variable, indicating some differentiation between the two variables.

We conducted a label manipulation test on the data of study 1. The results of independent sample t-test found that the labeled group considered the degree of specific labels contained in the material to be significantly higher than the unlabeled group ($M_{\text{label}} = 5.540$, $M_{\text{no label}} = 4.510$, $t(84.61) = 4.867$, CI95% [0.609, 1.450], $p < 0.001$). This indicates that the material stimulation is effective.

Next, we conduct the H1 test. First, we perform an independent samples T-test on the pro-environmental behavior scale data of the two experimental groups, using the presence or absence of labels as the grouping variable. The results indicate that the willingness to engage in pro-environmental behavior in the label condition is significantly higher than in the no label condition ($M_{\text{label}} = 5.620$, $M_{\text{no label}} = 4.959$, $t(95.91) = 2.991$, CI95% [0.222, 1.099], $p = 0.004$). Additionally, to verify the relationship between the independent and dependent variables, we also conducted a linear regression on the perception of labels and pro-environmental behavior willingness. The regression results, as shown in Table 1, indicate a significant positive linear relationship between

Variable	Model1				Model 2			
	B	SE	β	p	B	SE	β	p
Control variable								
Gender	0.213	0.274	0.082	0.438	0.253	0.266	0.097	0.344
Age	-0.035	0.168	-0.027	0.836	-0.101	0.164	-0.079	0.539
Occupation	0.121	0.079	0.2	0.128	0.138	0.077	0.229	0.074
Education level	0.301	0.175	0.18	0.088	0.263	0.17	0.157	0.125
Independent variable								
Behavior label	–				0.262	0.096	0.267	0.008
Constant	3.041	0.978		0.002	1.956	1.026		0.060
Model statistics								
R ²	0.067				0.136			
Adjusted R ²	0.027				0.089			
F-value	F (4,94) = 1.675				F (5,93) = 2.924			
significance	P = 0.162				P = 0.017			
ΔR^2	–				0.069			

Table 1. Hierarchical regression analysis results for pro-environmental behavior. 1.B = non-standardized coefficient, se = standard error, β = standardized coefficient, p = significance Model 1 contains only control variables, model 2 includes independent variables

the independent and dependent variables ($\beta = 0.267$, $t = 2.731$, $se = 0.096$, $p = 0.008$, $R^2 = 0.136$). The results support H1.

Discussion

Study 1 chose a travel and accommodation scenario as the context, manipulating experimental variables by presenting or not presenting labeled terms. Existing studies have shown that behavioral labels can promote the corresponding behaviors in experimental settings. For example, Martin P. Fritze found in his research on behavioral labels that the “fancing” label could encourage participants to make finger movements when listening to rhythmic music, the “lidcotting” label could make consumers avoid using plastic cup lids for takeaway tea, and the “up-smiling” label could encourage students to use more smile emojis in online class chats²⁰, preliminarily proving the applicability of behavioral labels.

Unlike existing literature that comprehensively studies behavioral labels from multiple aspects, study 1 focuses on the context of pro-environmental consumption behavior decisions and manipulates the experiments using relevant label materials, further proving the applicability of behavioral labels in the field of consumer pro-environmental behavior. Specifically, there is a significant difference in pro-environmental behavior outcomes when behavioral labels are present versus absent, and the presence of behavioral labels has a positive impact on consumers’ willingness to engage in pro-environmental behaviors. The results also confirm the correctness of H1. Whether and which intermediate variables are involved in this mechanism have not been verified in Study 1, so we designed Study 2 to explore whether personal norms and psychological imagery play mediating roles in this influence and whether they have a chain relationship as hypothesized in the theory.

Study 2

Study 1 found a significant correlation between behavioral labels and pro-environmental behaviors, supporting H1. This study was primarily designed to validate the mediating effects of the two mediator variables in H2, with the experimental design still being a between-subjects design (behavior description: label vs. no label). The independent and dependent variables were consistent with those in study 1, while also measuring the two mediator variables, mental imagery, and personal norms. The experiment was designed using another pro-environmental behavior, setting the experimental context as when consumers choose to use environmentally friendly floor materials when renovating their homes, and data were collected through questionnaires in credamo platform.

Procedure

The first part still involves label manipulation, using the same control methods as in Study 1. In the labeling section, the study labels the pro-environmental behavior of choosing eco-friendly floor materials when purchasing floor renovation materials as the noun “Green Paving.” For the no label condition, the text description method is similar to that in Study 1, and the materials highlight the pros and cons of the two choices, with specific descriptions provided in the Supplementary Methods 1. For the label condition, the materials add content related to labeling at the end, stating, “Here, we specially refer to the behavior of choosing eco-friendly floor materials during floor renovation as ‘Green Paving.’”

Similarly, after the participants completed the reading of materials related to label manipulation, we asked them to answer questions related to behavioral labels to test the effects of label manipulation. The questions were set as: How much do you think the specific expressions describing the act of choosing eco-friendly floor

materials when renovating is contained in the material text? As in Study 1, the meaning of “specific expression” was noted after the question.

The second part measures mental imagery and personal norms. The measurement of mental imagery uses a scale adapted from the study by Bone and Ellen The measurement scale for mental imagery was adapted from the study by Bone and Ellen⁵⁶, which is widely cited due to its multidimensional structure and good reliability and validity (original study $\alpha > 0.80$). This study adjusted the original scale’s descriptive content, and the adapted scale better meets the needs of the experiment. It including items such as “During reading the context of materials, I imagined what it would be like to choose to purchase eco-friendly floor materials when buying flooring materials.” The scale also uses seven-point Likert scale, with 1 = “Strongly Disagree” and 7 = “Strongly Agree.” Personal norms were measured using a scale derived from existing research and adjusted according to the background of this experiment, drawing on a scale by Kim S H et al.⁵⁷. The scale has reliable reliability and validity and is similar to the experimental context, both used to measure personal norms related to environmental protection issues. This study retains its core dimensions (moral obligation and guilt) and adjusts them according to the background of this experiment. We asked participants to rate items related to social norms and personal norms on a seven-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The items include " (1) I feel morally obligated to purchase eco-friendly floor materials, regardless of what others say.” among others. For details of the above scales, see Supplementary Table S2 to 3.

The third part measures pro-environmental behavior, similar to Study 1, by collecting data on this variable using a four-item scale adapted from Mukul Dev Surira et al.⁵⁴, including items such as “(1) I have the intention to purchase eco-friendly floor materials.” (See Supplementary Table S4.). The final part is used to collect the demographic information of the participants and is similarly included as a control variable.

Results

We final obtained 82 valid data sets, with 54 female samples and 28 male samples, and an average age of 30 years overall. In the reliability statistics of the questionnaire, the overall Cronbach’s Alpha value was 0.857, indicating good reliability. CFA showed that the model’s fit indices were good: $\chi^2/df=2.187$, GFI=0.767, CFI=0.853, RMSEA =0.121. In terms of convergent validity, the results showed that the CR for the conceptions of mental imagery, personal norms, and pro-environmental behavior were 0.587, 0.712, and 0.723, respectively, which were generally acceptable. In terms of discriminant validity, the \sqrt{AVE} for pro-environmental behavior ($\sqrt{AVE}=0.628$), personal norms ($\sqrt{AVE}=0.627$), and psychological imagery ($\sqrt{AVE}=0.572$) were greater than or close to their correlations with other factors (the highest r is between mental imagery and personal norms =0.641), and the exploratory analysis still showed that the variable of behavioral labels could form a factor alone (loading value=0.848). Overall, the measurement model of the conceptions had acceptable convergent and discriminant validity. The T-test results of the manipulation effect of the behavior label show that the manipulation is effective($M_{label}=5.710$, $M_{no label}=4.880$, $t(77.99)=4.141$, $CI95\% [0.436, 1.243]$, $p<0.001$).

Next, we conduct the main effect test. Using the same data processing and analysis methods as in Study 1, we perform an independent samples t-test, results still indicates that the pro-environmental behavior intention of the label condition is significantly higher than that of the no label condition ($M_{label} = 5.941$, $SD=0.676$; $M_{no label} = 5.494$, $SD=0.790$, $t(76.83)=2.746$, $CI 95\% [0.123, 0.771]$, $p=0.008$). Additionally, we also simply compare the mean values of mental imagery and personal norms in the label condition with those in the no label condition (Table 2), finding that the mean values of mental imagery and personal norms in the label condition are slightly higher than those in the no label condition.

Subsequently, hypothesis testing for the mediator parts was conducted. Chain mediation tests were directly performed using the process plugin in SPSS tools, and tested through model 6 with the bootstrap method. After adding statistical variables as control variables, the results are shown in the following table, indicating significant paths such as from behavioral labels to personal norms ($\beta = 0.398$, Bootstrap $CI95\% = [0.150, 0.711]$, $p = 0.001$, $R^2 = 0.149$), from personal norms to mental imagery factors ($\beta = 0.536$, Bootstrap $CI95\% = [0.258, 0.501]$, $p < 0.001$, $R^2 = 0.494$), etc. In the overall model test, the total effect of behavioral labels on pro-environmental behavior was significant ($\beta = 0.230$, Bootstrap $CI95\% = [0.057, 0.403]$). After adding the mediators, the direct effect was not significant ($\beta = -0.007$, Bootstrap $CI95\% = [-0.200, 0.157]$, $R^2 = 0.444$), but the total indirect effect through the two mediators was significant ($\beta = 0.235$, Bootstrap $CI95\% = [0.113, 0.400]$) (see Tables 3 and 4). Among the control variables affecting the dependent variable, age significantly positively predicted pro-environmental behavior in the final model ($\beta = 0.212$, $p = 0.025$), while other control variables had no significant impact (see Supplementary Table S5). The experimental data results to some extent can validate H2.

Discussion

In the study, we mainly conducted experimental designs for hypothesis testing of mediation effects. The experiment collected relevant data from participants and used SPSS for data analysis, with the analysis results validating H2.

Existing research has found that behavioral labels can evoke relevant mental imagery of the behavior, thereby enhancing the implementation of the behavior²⁰. But whether there are antecedents that influence mental image

Label/no label		Mental imagery	Personal norms
no label	Mean	5.683	5.094
label	Mean	5.825	5.298

Table 2. Mean of psychological imagery and mean of personal norms.

Predicted variable	coefficients (β)	SE	t	p	95% Bootstrap CI
Model 1 (Y = personal norms)					
Behavioral label	0.398	0.115	3.541	0.001	[0.150, 0.711]
constant term	2.716	1.183	2.297	0.024	[0.214, 4.756]
R ² = 0.149					
Model 2 (Y = mental imagery)					
Behavioral label	0.261	0.067	2.866	0.005	[0.080, 0.310]
personal norms	0.536	0.062	6.222	<0.001	[0.258, 0.501]
constant term	3.784	0.662	5.713	<0.001	[2.415, 5.240]
R ² = 0.494					
Model 3 (Y = pro-environmental behavior)					
Behavioral label (direct effect)	-0.007	0.081	-0.063	0.950	[-0.200, 0.157]
personal norms	0.340	0.087	2.905	0.005	[0.045, 0.493]
mental imagery	0.366	0.132	2.879	0.005	[0.094, 0.717]
constant term	1.488	0.893	4.479	0.000	[-0.318, 3.259]
R ² = 0.444					

Table 3. Results of primary variables in mediation model analysis.

Effect path	Effect size (β)	Boot SE	Boot LLCI	Boot ULCI
Total indirect effect	0.235	0.073	0.113	0.400
Behavioral label → personal norms → pro-environmental behavior	0.103	0.056	0.015	0.233
Behavioral label → mental imagery → pro-environmental behavior	0.073	0.041	0.012	0.169
Behavioral label → personal norms → mental imagery → pro-environmental behavior	0.060	0.036	0.010	0.150
Total effect (c)	0.230	0.087	0.057	0.403
Direct effect (c')	-0.007	0.091	-0.200	0.157

Table 4. Decomposition result of mediating effect.

play a mediating role has not been further explored. Previous researches on mental imagery mostly focus on the corresponding influence of sensory marketing on consumers’ mental imagery and its effect on their attitudes and behaviors, such as visual stimulation of websites can induce mental image, thus enhancing positive attitudes and behaviors, VR environment can shape stronger mental image, etc.^{58–60}, and there is no corresponding discussion on whether the standardization degree of individual internalization will have certain influence on the formation of mental intention.

The results showed that, under the experimental context of Study 2, consumers in the behavior label group are more willing to implement corresponding pro-environmental behaviors in the future compared to those in the no behavior label group, indicating that pro-environmental behavior labels played a promoting role in the experimental context, and the main effect was ensured.

More importantly, the data analysis results of Study 2 also indicate that the degree of internalization of norms can influence the formation of mental imagery, thereby demonstrating that behavioral labels can stimulate individuals’ norms, which in turn promotes the implementation of pro-environmental behaviors among consumers. That is, consumers have corresponding personal norms related to pro-environmental behavior. When behavior labels are present, consumers’ existing personal norms are more easily triggered compared to general situations, thereby more easily evoking their mental imagery, making the corresponding pro-environmental behavior more likely to occur.

The results of Study 2 proved the regulatory effect of our H2. To investigate the moderating effect of construal level in H3, we conducted Study 3.

Study 3

This study aims to validate the moderating effect of construal level, with an inter-group experimental design 2 (behavioral description: label vs. no label) × 2 (construal level: high vs. low), where the first and second parts are randomly set up, and participants will be randomly assigned to four scenarios. The experimental background is set in the context of choosing to purchase clothing, and data are still collected through questionnaires.

Procedure

The first part is the label manipulation materials. The design of the materials is similarly based on the experiments by Fritze et al.²⁰. We chose to assume a scenario of purchasing clothing and labeled the pro-environmental behavior of choosing to purchase green clothing as “Cuicai.” The text materials for the no label condition are provided in the Supplementary Methods 2. The materials for the label condition include the statement similar to those in previous experiments. After the participants read the materials related to label manipulation, they

were similarly asked to assess the degree of specific expressions describing the act of choosing to purchase environmentally friendly clothing, using a method similar to that used in previous studies.

In the second part, participants are randomly assigned to the high/low explanatory level part. The construal level manipulation draws on the form of construal level priming in the experiments designed by Liberman N et al.⁶¹, specifically by using language to guide participants into two different modes of thinking at high and low explanatory levels through the WHY/ HOW paradigm. Our experiment is designed to improve learning efficiency as the theme, requiring participants in the high-construal level group to think and answer “why” we need to improve learning efficiency, thus entering an abstract thinking mode; while participants in the low-construal level group need to think and answer “how” to improve learning efficiency, and to prevent careless responses, we also require answers to exceed 30 words and prohibit pasting. After completing that, we collect the participants’ explanation level data. We used the measurement method of Sinha J et al., assessing the construal level based on respondents’ preferences from multiple choice questions related to life, with a reference scale that has a certain validity ($\alpha=0.80$)⁶². We listed 10 questions for participants to choose from, to measure the size of the participants’ construal level. Specifically, it indicates their relative preference for high-level and low-level descriptions of 10 behaviors on a four-point scale. We summarize the responses of each participant and handle the reverse-scored items to derive the BIF score. A higher BIF score indicates a greater tendency towards higher levels of construal. The specific levels of explanation measurement scale are shown in the Supplementary Table S6, with * indicating reverse-scored items. The relevant text materials in the explanation level questionnaire are guided by the expressions of Zhang Jiemei et al.⁶³ (See Supplementary Methods 3).

The mental imagery and personal norms scale is consistent with study 2, all with three items and use a seven-point Likert scale, and the fourth part measures pro-environmental behavior, similar to the previous experiments, also including four items (see Supplementary Table S7 to 9). Finally, demographic information of the participants is collected.

Results

We final obtained 188 valid data samples, including 137 female samples and 51 male samples with an average age of 32 years. In the reliability statistics of the questionnaire, the overall Cronbach’s Alpha value based on standardized items is 0.863, indicating good reliability. The CFA analysis results show that the model fit indices are $\chi^2/df=1.525$, CFI=0.928, RMSEA=0.053, indicating good model fit. In terms of convergent validity, the AVE values and composite reliability for personal norms (AVE=0.511, CR=0.805) and pro-environmental behavior (AVE=0.652, CR=0.881) are both above the threshold (AVE>0.5, CR>0.7), and most standardized factor loadings are greater than 0.7, supporting good convergent validity; the CR values for interpretation level and mental imagery are also close to 0.7 (CR_{construal level}=0.699, CR_{personal norms}=0.620). In terms of discriminant validity, the AVE square roots for personal norms ($\sqrt{AVE}=0.715$), pro-environmental behavior ($\sqrt{AVE}=0.807$), mental imagery ($\sqrt{AVE}=0.610$), and interpretation level ($\sqrt{AVE}=0.448$) are generally greater than their correlations with other factors, indicating a certain level of discriminant validity overall.

We tested the labels and construal levels. We conducted an independent samples T-test on the label test scale data collected from the label condition and the no label condition, results indicate that the mean values of behavioral label perception data between the label condition and the no label condition are different and significant ($t(176.748)=5.358$, CI95% [0.527, 1.142], $p<0.001$, $se=0.156$; $M_{\text{label}}=5.550$, $SD=0.961$; $M_{\text{no label}}=4.720$, $SD=1.161$). This suggests that the manipulation of the label variable in the experiment was successful. The independent samples t-test shows that participants in the label condition associated specific words more strongly with the described activity than participants in the no label condition, confirming the overall effectiveness of the operations in both conditions.

We tested the effect of manipulation on the level of construal. The results showed that there was a difference between the two experimental groups, and it was significant, indicating that the manipulation of the variable of construal level was successful. ($t(181.152)=2.419$, CI95% [0.033, 0.322], $p=0.017$, $d=0.073$; $M_{\text{high construal level}}=3.253$, $SD=0.489$, $n_{\text{high construal level}}=99$; $M_{\text{low construal level}}=3.075$, $SD=0.515$, $n_{\text{low construal level}}=89$).

Under high construal level, the participants in the label condition showed a higher willingness for pro-environmental behavior compared to those in the no label condition ($M_{\text{labeled}}=5.085$, $M_{\text{unlabeled}}=4.975$), and the same result was found under low elaboration ($M_{\text{label}}=5.217$, $M_{\text{no label}}=5.145$). Additionally, a linear regression analysis was conducted to examine the extent to which participants endorsed the labeled material and their corresponding willingness for pro-environmental behavior, and it was found that there was a significant positive correlation ($p=0.008$ $\beta=0.185$, $se=0.068$, $R^2=0.171$).

Subsequently, for the test of the moderating effect of construal level in the overall model, the study also conducted effect analysis using the effect test plugin in SPSS, with behavioral labels as the independent variable, personal norms as mediator variable 1, mental imagery as mediator variable 2, construal level as the moderator, pro-environmental behavior as the dependent variable, and statistical variables as control variables. The 83 model in the process plugin was used for testing. All continuous variables were mean-centered, and the results are shown in (Supplementary Table S10, Tables 5 and 6). The results indicate that among the control variables, only age has a positive effect on personal norms. Other results show that the control variables did not reach a significant level at the 95% confidence level, and the moderating effect of construal level on personal norms is marginally significant at the 95% confidence level (interaction term $p=0.057$, $R^2=0.213$).

The results show that the interaction term coefficient of the construal level is negative ($\beta=-0.219$). Compared to the model without moderation, the positive impact of the behavioral label on individual norms is weakened after the moderation is added. When the construal level is high (+1SD), the impact is not significant ($\beta=0.036$, $p=0.660$). After adding the moderation variable or interaction term to the model, the explanatory power of the dependent variable is improved by 0.016 ($R^2\text{-chgng}=0.016$). That is, the moderation variable of construal level,

Moderator variable (construal level)	Level	Effect of behavioral label → personal norms	SE	t	p	95% CI
Low (-1 SD)	-0.507	0.259	0.095	2.717	0.007	[0.071, 0.446]
Average (0)	0	0.147	0.068	2.181	0.031	[0.014, 0.281]
High (+1 SD)	0.507	0.036	0.083	0.441	0.660	[-0.127, 0.199]

Table 5. Moderation effect test of model 1. Significance of interaction items: behavioral label × construal level
的 $\Delta R^2 = 0.016$, $F(1,180)=3.666$, $p=0.057$ (marginally significant).

Model and variables	B	SE	t	p	95 % CI	Bootstrap 95 % CI
Model1 (Y = personal norms)						
constant term	3.110	0.708	4.393	<0.001	[1.713, 4.507]	[1.587, 4.783]
Behavior label (X)	0.147	0.068	2.181	0.031	[0.014, 0.281]	[0.015, 0.301]
Construal level (W)	0.350	0.151	2.316	0.022	[0.052, 0.647]	[0.049, 0.667]
Behavior label × construal level (interaction term)	-0.219	0.115	-1.915	0.057	[-0.445, 0.007]	[-0.460, 0.062]
$R^2 = 0.213$						
Model 2 (Y = mental imagery)						
constant term	4.220	0.438	9.627	<0.001	[3.355, 5.085]	[3.311, 5.062]
Behavior label	0.092	0.040	2.292	0.023	[0.013, 0.172]	[0.008, 0.182]
Personal norms (M1)	0.342	0.044	7.799	<0.001	[0.256, 0.429]	[0.246, 0.448]
$R^2 = 0.330$						
Model 3 (Y = pro-environmental behavior)						
Constant term	0.343	0.572	0.600	0.549	[-0.786, 1.473]	[-0.595, 1.289]
Behavioral label (direct effect)	0.041	0.044	0.944	0.347	[-0.045, 0.127]	[-0.056, 0.139]
Personal norms (M1)	0.719	0.054	13.353	<0.001	[0.613, 0.826]	[0.571, 0.838]
Mental imagery (M2)	0.183	0.079	2.314	0.022	[0.027, 0.338]	[0.012, 0.374]
$R^2 = 0.680$						

Table 6. Regression analysis results for the moderating effects of major variables.

to a certain extent, weakens the impact of the behavioral label on the personal norms. In other words, when the construal level increases, the impact of the behavioral label on personal norms is actually weakened.

In summary, the data from this experiment indicate that construal level has a moderating effect, and that this construal level weakens the impact of behavioral labels on personal norms, playing a negative moderating role in the model.

Discussion

In the study 3, the parts concerning H1 and H2 were also further validated. In the validation of the moderating effect of the construal level, we hypothesized in the theoretical part that it plays a positive moderating role in the effect of behavioral labels on personal norms. However, the analysis of experimental data showed that the level of explanation actually plays a negative moderating role in this mechanism. For the experimental results that did not conform to the research hypothesis, we discussed the following to explain why there was a deviation between the experimental results and the hypothesis:

We have already clarified in the theoretical foundation section that individuals with high construal level are more focused on the abstract core aspects, such as the long-term impact and essential significance of behavior; whereas individuals with low construal level may be more focused on specific and concrete aspects, meaning they are more concerned with the immediate consequences or specific details of behavior⁵¹. But it is worth considering further whether people respond differently to given behavioral labels in different decision-making contexts (such as future versus present)? We speculate that this difference is what leads to certain discrepancies between the experimental data analysis results and the original moderating effect assumptions. Existing research proposes that time distance influences decision-making through the construal level: distant decisions (such as retirement savings) activate high levels of construal, making consumers more focused on abstract consequences (such as “future security”)⁶⁴.

Specifically, psychological distance refers to a subjective perception of the distance from other things, with reference to oneself at the time and place, including four dimensions: time, space, social, and hypothetical, which share a common psychological representation mechanism, namely the Construal Level Theory (CLT). The closer the temporal distance, the closer the psychological distance, and individuals are more inclined to use low-level construal—focusing on specific, contextual, and detailed features⁴⁹. When the temporal distance is short (the decision context is recent), low-level construal is more aligned with the context, and this fit effect is enhanced by processing fluency, thereby strengthening cognitive coherence and behavioral intentions. This cognitive coherence promotes consistency between the projection of behavioral labels and the individual’s existing norms⁶⁵. That is, recent decisions are more aligned with individuals with low construal levels, promoting greater

consistency in behavior, and low construal level consumers are more likely to respond to behavioral labels, thereby implementing corresponding pro-environmental behaviors.

When choices occur in the distant future, they are interpreted as being at a higher, more abstract, and goal-oriented level; whereas when choices are in the near future, they are interpreted as being at a lower, more specific, and detail-oriented level⁶⁶. It can thus be inferred that long-term decisions are more influenced by the awareness of consequences, and individuals with high construal levels will have a stronger sense of the outcomes of the corresponding actions, making them more likely to accept and respond to such information.

In summary, we believe that in long-term decision-making contexts, individuals are more focused on future issues, with the impact of psychological distance diminished. Construal levels primarily awaken personal norms (moral obligations) by enhancing awareness of consequences. Individuals believe that choosing to implement related pro-environmental behaviors over the long term is a responsible and moral choice, thereby enhancing their pro-environmental behavior intentions. At this time, individuals with higher construal levels tend to view behavior as a long-term responsibility and have stronger behavioral intentions; conversely, individuals with lower explanatory levels do the opposite. And in current or recent decision-making contexts, individuals need to focus on immediate behavioral issues. Due to their greater psychological distance [0], high construal level processors are more likely to ignore the consequences of recent behaviors, whereas low construal level processors are more focused on the present and can more directly link behavioral labels to personal norms, thereby enhancing their moral perception of immediate behaviors and promoting pro-environmental actions. In the experimental design, materials prompted participants to think about current specific issues, so the experimental results showed that construal level had a negative moderating effect on the impact of behavioral labels.

In marketing contexts, it is more about prompting consumers to think about current, immediate behavioral decision-making issues. For the issue of shaping pro-environmental behavior awareness, it is given as a long-term issue. Further theoretical exploration in this area can provide more support for the practical application of behavioral labels. Of course, whether there are other factors remains to be explored.

Main findings and theoretical implications

Research findings

The main conclusions of this research are as follows:

- (1) Pro-environmental behavior labels can promote the corresponding pro-environmental behaviors. That is, based on research findings, the promoting effect of behavior labels on behavior also exists in the field of pro-environmental behavior. When consumers are faced with scenarios related to pro-environmental behavior, by providing a unique labeled term associated with this pro-environmental behavior, it can effectively promote the implementation of the corresponding pro-environmental behavior by consumers.
- (2) The activation of personal norms by behavior labels can influence the corresponding mental imagery, thereby promoting the corresponding pro-environmental behavior. That is, personal norms and mental imagery chains mediate the effect of behavioral labels on pro-environmental behavior. Specifically, personal norms related to pro-environmental behavior already exist in consumers. When there is a stimulus of a behavior label, compared to usual circumstances, the consumer's existing personal norms are more likely to be activated, thus more easily triggering their inner mental imagery, making the corresponding pro-environmental behavior associated with the label more likely to occur.
- (3) We also further analyzed the experimental results and found that in recent behavioral decision-making scenarios, the construal level has a negative moderating effect on the influence of pro-environmental behavior labels on pro-environmental behavior. However, in the long term, the construal level has a positive moderating effect on it.

Theoretical implications

Our research revolves around the core question of whether “behavioral labels will still play a role in the consumption context of pro-environmental behavior,” exploring the mediating roles of personal norms and mental imagery. We also investigate how the influence of behavioral labels on pro-environmental behavior changes under different levels of construal, further exploring the interaction effects of consumer construal levels, pro-environmental behavior labels, and related mediating variables on consumer pro-environmental behavior. The research results enrich the literature on pro-environmental behavior and related fields.

Specifically, we designed three experiments and analyzed the obtained data to explore the impact of behavioral labels on consumer pro-environmental behavior. The main theoretical implications are as follows:

- (1) Our research enriches the cross-disciplinary perspective on pro-environmental consumer behavior with other research fields. First, we use a unique angle to study pro-environmental behavior. Our study takes a consumer-centric approach, referencing relevant literature in the field of language studies, using “behavior labels” to describe pro-environmental behavior and incorporating it into consumption contexts. Second, unlike existing research on behavior labels, we introduced two new variables, “construal level” and “personal norms,” based on the theory of construal level and personal norm theory, which are different from the existing variables in behavior label mechanisms. The research findings show that using “behavior labels” can promote consumers' corresponding actions to some extent in the same pro-environmental consumption context. This is because consumers' corresponding personal norms and mental imagery play a role after reading these labels, ultimately promoting the occurrence of this behavior.
- (2) Our research provides new insights for the study of mental imagery theory, deepening the understanding of the mechanisms of mental imagery formation. The study constructs the relationship between personal norms and mental imagery through literature, finding that consumers who internalize behavioral norms

to a higher degree may be more likely to generate vivid mental imagery in response to behavior labels, and this imagery further strengthens behavioral intentions. The study also proves through experiments that in some consumption scenarios, there is a significant path relationship between personal norms and mental imagery. The stronger the personal norm related to the behavior in the consumer's mind, the easier it is to awaken their mental imagery. Our results provide a new insight for related research on mental imagery.

- (3) In addition, our research also makes some theoretical contributions to the theory of construal level. We found that consumers' construal level has a certain moderating effect on the above-verified path mechanism in these recent behavioral decision-making contexts in the experiments. Our study also analyzed and discussed the impact direction and magnitude of the construal level on the relationship between behavioral labels and personal norms in different contexts. It was found that in the recent behavioral decision-making context of the experiment, the pro-environmental behavioral label had an impact on pro-environmental behavior and the corresponding mediator variables consistent with theoretical hypothesis. However, the regulatory role of the construal level variable in different contexts may have changed due to the perception of near and distant time, resulting in a negative regulatory effect on the corresponding paths. That is, compared to consumers with low construal levels, those with high construal levels experienced a decrease in the impact of pro-environmental behavioral labels on pro-environmental behavior in the label context. Our results of this study indicate that the decision-making context in the near and distant future has impact on the construal level, providing some thoughts for future research on the relationship between the construal level and consumer decisions.

In addition, our research method has the following advantages over existing studies: firstly, the methodological design is tailored to the specific context of pro-environmental behavior, which strengthens the domain-specific validity of our results. Secondly, our parsimonious approach to manipulating the experimental conditions produced outcomes that are both clearer and more straightforward to interpret. Finally, compared to previous studies that only examined main effects and mediator effects, we also examined moderating effects, which improved the accuracy of the results.

Practical implications

Firstly, in a company's marketing management, when products involve the concept of being environmentally friendly, relevant product consumption behaviors can be labeled and used in the promotional process to help people awaken related awareness and deepen their impressions, further promoting the occurrence of consumption behavior.

Second, it is very important for consumers to have personal norms related to environmentally friendly behaviors. In the marketing process, companies can influence consumers' understanding of related environmentally friendly behaviors through public welfare, recycling, and other environmentally friendly actions, helping consumers establish personal norms related to environmentally friendly behaviors. Combining these with tag descriptions of advertisements for product purchases and other value-adding behaviors can help consumers implement environmentally friendly consumption behaviors.

Additionally, research results indicate that shaping a good marketing environment helps build consumers' mental imagery of pro-environmental behaviors, which can enhance the effectiveness of pro-environmental behavior labels. Companies can control the exposure of marketing information to consumers by choosing the methods and locations of advertising placements, thereby influencing consumers' perceptions of the environment. They can opt for quiet locations (such as libraries, bookstores, schools, etc.) or time periods when the target consumers are more likely to be in a calm state (such as at home) for online advertising placements, increasing the accuracy of information recognition to awaken mental imagery, and thus promoting consumer behavior.

Of course, when facing different marketing scenarios (such as promoting long-term consumption rather than short-term consumption), companies should first understand the level of construal of the target group for the product, and based on this level of explanation and the context, decide whether to use labels to better leverage the role of behavior labels.

Finally, when promoting policies related to pro-environmental behavior, behavior labels can be used to encourage individuals and groups to take actions that align with environmental benefits. For example, sports can be used as a way to promote pro-environmental behavior, by guiding people to practice environmental protection during sports activities, which can to some extent promote sustainable development.

Limitations and future research

Although we have obtained certain results through experimental research, our study still has some limitations. First, we only examined the relevant roles of variables such as behavioral labels in consumer purchase behaviors. For other pro-environmental behaviors, such as the selection of travel modes and the choice of promotional gifts for different types of consumers, we did not individually validate the effectiveness of behavioral labels through experiments. Future research can further categorize and explore whether there are differences or consistencies in the effectiveness of behavioral labels in these scenarios.

Second, we have not yet experimentally verified whether the variable of construal level shows stable negative and positive regulatory differences in different decision-making contexts (short-term or long-term). Additionally, we have not further explored the impact of construal level on other paths in the model, such as whether construal level also has a moderating effect on the influence of personal norms on mental imagery, or whether it has a moderating effect on the influence of mental imagery on pro-environmental behavior.

Finally, our findings are culturally situated. Our participant pool was exclusively composed of Chinese respondents, and the number of samples has a certain limitation. The motivations for pro-environmental behavior

are known to be deeply culturally embedded, for example, collectivist cultures may differ from individualist cultures in terms of behavioral norms and construal levels. A direct replication of this experiment in a different cultural context, such as European country, is necessary to test the universality of our conclusions. This is a critical step for establishing the external validity of the proposed theoretical model. In addition, although basic demographic data was collected, our analysis did not deeply explore how these variables might moderate the key results. It is plausible that factors such as age, income level, urban vs. rural residence, or educational background could create significant variation in how individuals respond to the experimental manipulation. Future research should deliberately oversample from diverse demographic groups to analyze these potential interaction effects, which would help tailor practical applications to specific audiences.

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Received: 11 June 2025; Accepted: 1 September 2025

Published online: 06 October 2025

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Author contributions

X.H. and J.L. jointly conceived the research concept and designed the study framework. X.H. established the methodological approach, provided continuous supervision throughout the research process, and acquired necessary funding support. J.L. conducted data collection and empirical analysis, including statistical modeling and hypothesis testing. In the manuscript preparation phase, J.L. took primary responsibility for drafting the initial manuscript text and creating data visualizations (all tables and figure). X.H. performed critical revisions of the full manuscript, enhancing theoretical depth and methodological robustness. Both authors participated actively in result interpretation and discussion development. The final manuscript was thoroughly reviewed and approved by both X.H. and J.L.

Funding

This work was supported by the National Natural Science Foundation of China [Grant Numbers 72062001, 71872055], Guangxi Natural Science Foundation [Grant Numbers 2024GXNSFAA010005].

Declarations

Competing interests

The authors declare no competing interests.

Ethics approval

All experimental procedures were reviewed and approved by the Guangxi University Medical Ethics Committee (Approval No. GXU-2025-077), ensuring compliance with ethical standards and regulations.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Statement of compliance

All methods were performed in accordance with the relevant guidelines and regulations.

Additional information

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1038/s41598-025-18357-4>.

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