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RESEARCH ARTICLE

The impact mechanism of Eco-labels on consumer purchase intention in international trade: A cross-cultural psychological perspective

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ABSTRACT

In response to escalating global environmental challenges and the growing prominence of eco-labeling as a market-based sustainability instrument, this research examines the psychology of culture to analyze the dynamics of eco-labels in international trade and their effects on consumer purchase intentions. Drawing on the Theory of Planned Behavior and Hofstede's cultural dimensions framework, we investigate how purchase decisions vary across cultures regarding eco-label attributes. Using structural equation modeling with data from 1,824 consumers across six culturally diverse countries (United States, Germany, Japan, South Korea, Brazil, and Netherlands), selected through stratified random sampling to maximize cultural diversity representation, we found significant cross-cultural differences in eco-label effectiveness mediated by environmental concern, perceived consumer effectiveness, and green trust. Collectivistic consumers responded more positively to eco-labels emphasizing community benefits, while individualistic consumers preferred personal benefit framing. Uncertainty avoidance moderated the relationship between eco-label credibility and consumer trust in third-party certifications, while long-term orientation influenced the effectiveness of comprehensibility cues. These findings advance sustainable marketing theory and provide actionable strategies for international marketers by demonstrating the importance of culturally-contextualized eco-labeling approaches. For policymakers and eco-label governance bodies, this research offers empirical evidence for developing culturally-sensitive certification frameworks that accommodate diverse consumer information processing styles while maintaining universal credibility standards. The cultural contingency framework developed provides foundations for optimizing eco-labeling policies across international markets, ultimately contributing to more effective sustainable consumption promotion across diverse cultural contexts.

Keywords: Eco-labeling effectiveness; cross-cultural consumer behavior; sustainable marketing; cultural dimension theory; green purchase intention

1. Introduction

With global environmental degradation accelerating and international trade reaching unprecedented volumes, the urgent need for effective sustainability communication mechanisms has never been more critical. Eco-labeling has emerged as one of the most prominent and rapidly expanding market instruments aimed at promoting sustainable consumption on a global scale, with the global eco-label market projected to

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reach $11.7 billion by 2025 (Global Market Insights, 2023). These environmental certifications serve as crucial bridges across information asymmetries between producers and consumers by communicating the ecological characteristics of products, yet their effectiveness varies dramatically across cultural contexts—a variation that could determine the success or failure of global sustainability initiatives[1]. In the context of rapidly expanding international economic relations and the global push toward sustainable development goals, understanding how eco-labels influence consumer purchase intentions across different cultural settings has become a critical imperative for both academic researchers and sustainability practitioners[2]. Despite the proliferation of over 450 eco-labeling schemes worldwide (UNEP, 2023), a fundamental research gap persists: while numerous studies have examined eco-label effectiveness within single cultural contexts, virtually no comprehensive framework exists for understanding how cultural dimensions systematically moderate the psychological mechanisms through which eco-labels influence consumer behavior across international markets[3,4]. This gap is particularly problematic given that most global brands employ standardized eco-labeling strategies that may be ineffective or even counterproductive in certain cultural contexts. This study addresses this gap by examining the influence of cross-cultural psychology on the mechanisms of eco-labels in relation to international trade and their impact on consumer purchase intention.

The critical originality and necessity of this research stems from its systematic integration of cross-cultural psychology with consumer behavior theory to construct the first comprehensive model of psychological pathways through which eco-labels affect purchasing behavior across diverse cultural contexts. While existing research has identified individual mediating factors such as perceived consumer effectiveness, environmental concern, and green trust in single-culture studies[5,6], no previous research has systematically examined how these mechanisms operate differently across cultural boundaries, nor how cultural dimensions specifically moderate these psychological pathways. This represents a significant theoretical and practical void, as the $2.4 trillion global sustainable products market increasingly depends on effective cross-cultural communication strategies. These mechanisms fundamentally vary across cultures due to underlying sociocultural frameworks such as individualistic versus collectivistic orientation, uncertainty avoidance, and long-term orientation[7,8]. The absence of this cultural understanding represents more than an academic gap—it constitutes a practical crisis for multinational corporations investing billions in sustainability marketing, policymakers designing international environmental standards, and consumers seeking authentic environmental information. This research addresses this critical void by providing the first systematic framework for understanding how cultural dimensions moderate the psychological mechanisms of eco-label effectiveness, thereby advancing both sustainable marketing theory and international marketing practice in ways that could significantly impact global sustainability outcomes[9,10].Furthermore, the study of the relationship between social reference groups and the intention to consume environmentally friendly products from diverse cultural perspectives improves the understanding of the social determinants of responsible consumer behaviour to protect the environment[3,11].

The practical urgency of this study extends across multiple stakeholder groups facing immediate sustainability challenges. For international marketers managing increasingly environmentally conscious consumers who represent over 73% of global shoppers (Nielsen, 2023), understanding cultural differences in eco-label perception has become essential for competitive survival rather than mere marketing optimization[12,13]. For policymakers tasked with meeting Paris Agreement targets and Sustainable Development Goals, the effectiveness of eco-labeling frameworks in diverse cultural contexts directly impacts the success of national and international environmental policies.The results will enable international businesses to devise appropriate strategies for developing eco-labels and marketing green products that not only align with consumer sentiments but also comply with international standards of sustainability [14, 15].

Additionally, this study aids policymakers in understanding how eco-labeling frameworks can be optimised in specific cultural settings to effectively promote sustainable consumption practices[16-18]. By systematically identifying the specific cultural dimensions that enhance or diminish eco-label impact and developing actionable strategies for culturally-adaptive sustainability communication, this study provides the missing theoretical and practical foundation for achieving sustainable consumption on a global scale. The framework developed here could fundamentally transform how international sustainability initiatives are designed, implemented, and evaluated across diverse cultural markets.

2. Literature review

2.1. Eco-labels in international trade

Eco-labels have evolved from niche environmental marketing tools to central components of international trade governance, serving as crucial instruments for communicating environmental product characteristics to consumers[1]. Kumar and Basu (2023) demonstrated that eco-labels significantly trigger green product purchase intention among emerging market consumers, yet their effectiveness varies substantially across different cultural contexts[1]. This variation suggests that standardized global eco-labeling approaches may be inadequate for diverse international markets. The complexity of eco-labeling in international trade stems from the proliferation of different certification schemes and varying levels of credibility. Sala et al. (2020) conducted a comprehensive review of academic literature and global label initiatives, revealing over 450 active eco-labeling schemes worldwide with significant variations in verification standards and consumer recognition[18]. These certification processes range from self-declarations to rigorous third-party verifications, creating consumer confusion due to varying levels of independence and credibility across different markets. International trade governance presents unique challenges for eco-labeling standardization. The European Commission's strategic work plan for 2020-2024 highlights the need for harmonized approaches while acknowledging cultural and regional differences in environmental priorities[21]. However, Pandya and Haribhakti (2024) note that legal frameworks for sustainable consumption vary significantly across jurisdictions, creating potential non-tariff barriers when eco-labeling requirements differ disproportionately between countries[17]. This is particularly burdensome for producers in developing countries, who face unbalanced compliance challenges when accessing markets with strict environmental certification requirements. The effectiveness of eco-labels as communication and policy tools in international contexts remains limited by cultural factors that influence consumer perception and acceptance. While comprehensive certification infrastructures exist in developed markets, emerging economies often exhibit scattered approaches to environmental product labeling, reflecting different sustainability priorities and regulatory frameworks. This disparity necessitates the development of culturally-sensitive approaches that can accommodate diverse consumer processing styles while maintaining universal credibility standards.

2.2. Consumer purchase intention towards Eco-labeled products

Consumer purchase intention toward eco-labeled products represents a multifaceted psychological phenomenon influenced by various cognitive, affective, and social factors. Beccaris et al. (2022) identified green trust as a critical mediator in the relationship between green advertising skepticism, environmental knowledge, and intention to buy green food, demonstrating the central role of trust-based mechanisms in environmental consumer behavior [5]. This finding is supported by Chen and Chang (2021), who established that green trust mediates the effects of green consumer confusion and green perceived risk on purchase intentions[10]. The psychological pathways through which eco-labels influence consumer behavior operate through multiple mediating mechanisms. Environmental concern emerges as a fundamental driver, with

Lopes et al. (2024) demonstrating how environmental concerns mediate consumer decision-making processes in green product evaluation[4]. Similarly, perceived consumer effectiveness—consumers' belief that their individual actions can contribute to environmental solutions—plays a crucial role in translating environmental awareness into purchase intention. However, these psychological mechanisms appear to vary significantly across cultural contexts. Singh et al. (2021) highlighted the importance of cross-cultural perspectives on sustainable consumption, noting that consumer motivations and promotional effectiveness differ substantially between individualistic and collectivistic societies[7]. Wang (2024) further demonstrated that marketing strategies and consumer behavior under different cultural backgrounds require distinct approaches to achieve effectiveness[8]. The role of reference groups and social norms adds another layer of complexity to eco-label effectiveness. Suki et al. (2023) found that intentions to purchase eco-friendly products differ between national and foreign consumers, suggesting that cultural identity and social context significantly influence environmental purchase decisions [11]. Ahmad and Zhang (2020) extended this understanding by showing how electronic service quality and customer green psychology interact to affect green purchase intention, indicating that technological and cultural factors jointly shape consumer responses to environmental information[12]. Recent research has emphasized the importance of trust and credibility in eco-label effectiveness. Wu and Long (2024) demonstrated how perceptions of information usefulness and green trust influence intentions toward eco-friendly purchases in social media contexts, highlighting the evolving landscape of environmental communication[3]. However, a critical gap remains in understanding how these established psychological mechanisms operate differently across diverse cultural contexts, particularly in international trade settings where consumers from various cultural backgrounds evaluate the same eco-labeled products.

2.3. Cross-cultural psychology in consumer behavior

Cross-cultural psychology provides essential insights into how cultural value systems shape consumer behavior, particularly in the context of environmental decision-making. Singh et al. (2021) established that cross-cultural perspectives fundamentally influence sustainable consumption patterns, with significant implications for consumer motivations and promotional strategies across different cultural contexts[7]. These cultural differences manifest in distinct information processing styles, evaluation criteria, and decision-making mechanisms that directly impact eco-label effectiveness. Cultural dimensions create systematic variations in how consumers respond to environmental marketing communications. Wang (2024) demonstrated that marketing strategies and consumer behavior vary significantly under different cultural backgrounds, necessitating culturally-adapted approaches to achieve optimal effectiveness[8]. Collectivistic societies tend to respond more strongly to socially-based environmental approaches and appeals that emphasize community benefits and social responsibility. Conversely, individualistic societies demonstrate stronger responses to arguments highlighting personal advantages and individual environmental impact. The cultural context also influences how consumers process and evaluate environmental information. High-context cultures rely more heavily on implicit communication modes, including symbols and visual elements in eco-labels, while low-context cultures focus more on explicit information and factual content about measurable environmental impacts. These fundamental differences in information processing styles suggest that standardized global eco-labeling approaches may be ineffective across diverse cultural markets. Recent research has begun to explore the intersection of cultural factors with digital communication channels. Wu and Long (2024) examined how cultural context influences perceptions of information usefulness and green trust in social media environments, revealing that cultural values moderate the effectiveness of online environmental communication [3]. Similarly, Machado et al. (2022) investigated how eco-labels and user-generated content influence green purchase intention, suggesting that cultural factors shape the relative

effectiveness of different communication channels[13]. Despite these advances, significant gaps remain in our understanding of cross-cultural environmental consumer behavior. While individual studies have identified cultural differences in environmental values and purchase behaviors, no comprehensive framework exists for understanding how specific cultural dimensions systematically moderate the psychological mechanisms through which eco-labels influence consumer behavior. This theoretical gap limits both academic understanding and practical application of eco-labeling strategies in international markets, where cultural diversity represents both a challenge and an opportunity for promoting sustainable consumption patterns.

2.4. Theoretical integration and hypothesis development

The complex ways in which cultural factors influence eco-label effectiveness become apparent through examining the intersection of eco-label literature, consumer behavior, and cross-cultural psychology. While the Theory of Planned Behavior (TPB) provides foundational constructs including attitude, subjective norms, and perceived behavioral control[2], the cross-cultural eco-labeling context necessitates a more nuanced theoretical approach. Our selection of Environmental Concern, Perceived Consumer Effectiveness, and Green Trust as primary mediators is theoretically justified through three critical considerations, building on established environmental psychology frameworks [4,5] and cross-cultural consumer behavior research[7,8]. First, Environmental Concern represents the value-based motivational foundation that transcends cultural boundaries while manifesting differently across cultural contexts, making it essential for cross-cultural comparison. Second, Perceived Consumer Effectiveness specifically captures the self-efficacy dimension of environmental action, which cultural psychology research demonstrates varies significantly between individualistic and collectivistic societies. Third, Green Trust addresses the credibility assessment mechanism that becomes paramount in cross-cultural contexts where institutional trust varies substantially between countries.

This constellation of mediators offers advantages over traditional TPB constructs in the eco-labeling context. While attitudes and subjective norms from TPB are valuable, they represent more general psychological constructs that may not capture the specific mechanisms through which environmental information is processed across cultures. Environmental Concern provides deeper insight into value-based motivations than general attitudes, Perceived Consumer Effectiveness offers more precision than broad perceived behavioral control in the sustainability domain, and Green Trust captures the verification mechanisms that are particularly critical when consumers evaluate environmental claims across different institutional contexts. Framed this way, eco-labels have been found to operate through numerous psychological frameworks that cultures differentially use to mediate the impact an eco-label has on an individual. Such logic demands one to consider both mediating pathways and intervening variables within a cultural effect model in conjunction with direct impacts.

Building on this integrated framework, we formulated hypotheses to test – First, eco-label features likely are directly proportional to the intention to buy within a given context which is anthropological in nature and thus, proportionate to the scope that a given culture is used. Second, irrespective of how Pro-Environmental agendas are considered, the perception of consumer empowerment, and green trust this hypothesised phenomenon, they carry strong influence on behavioral intentions set from eco-labels and thus, serve as active mediating fundamentals. Third, eco-labels are culture-free phenomena triggered by specific moderating conditions that sharpen or blunt the impact of individualism-collectivism along with long term orientation and uncertainty avoidance functioning as cultural dimensions. Integrating all these aspects addresses issues that existing frameworks have ethnocentrically created in studying eco-labels across cultures and sets forth building blocks for analysing eco-label efficacy.

3. Theoretical framework and hypotheses

3.1. Conceptual model development

The conceptual framework for this research integrates eco-label attributes, psychological mechanisms, and cultural dimensions into a comprehensive model explaining cross-cultural variations in consumer purchase intention. Central to this framework is the relationship between eco-label characteristics and purchase intention, which can be expressed as

$$PI = f(EL, PM, CD) \tag{3.1}$$

where PI represents purchase intention, EL denotes eco-label attributes, PM signifies psychological mechanisms, and CD represents cultural dimensions. The model proposes that eco-label attributes—including design elements, certification type, and informational content—directly influence purchase intention through a coefficient pathway represented as $\beta_{EL\to PI}$. Additionally, these attributes operate through multiple psychological mediators, where the indirect effect can be calculated as

$$\beta_{EL\to PM} \times \beta_{PM\to PI} \tag{3.2}$$

The total effect of eco-labels on purchase intention thus becomes

$$TE = \beta_{EL\to PI} + \sum(\beta_{EL\to PM_i} \times \beta_{PM_i\to PI}) \tag{3.3}$$

where i represents distinct psychological mediators. Cultural dimensions moderate these relationships by altering pathway coefficients, represented as $\beta_{EL\to PI|CD}$ for direct effects and $\beta_{EL\to PM|CD} \times \beta_{PM\to PI|CD}$ for mediated pathways. The conditional total effect becomes

$$TE_{CD} = \beta_{EL\to PI|CD} + \sum(\beta_{EL\to PM_i|CD} \times \beta_{PM_i\to PI|CD}) \tag{3.4}$$

This culturally contingent model enables systematic cross-cultural comparison by establishing mathematical equivalence of measurement across cultural contexts while allowing for variation in relationship strength.

The theoretical superiority of our selected mediator framework over alternative approaches lies in its cultural sensitivity and domain specificity, consistent with cross-cultural marketing research that emphasizes cultural adaptation in consumer behavior models[8,13]. Traditional consumer behavior models often assume universal psychological processes, failing to account for how cultural values shape the interpretation of environmental information. Our framework explicitly recognizes that environmental concern manifests through different cultural lenses—as collective responsibility in communitarian cultures versus individual stewardship in individualistic contexts. Similarly, perceived consumer effectiveness varies culturally based on beliefs about individual agency versus collective action, while green trust reflects culturally-embedded institutional credibility assessments. This culturally-contingent mediation model provides a more sophisticated understanding of eco-label effectiveness than generic attitude-intention models, enabling precise cross-cultural predictions about when and why eco-labels succeed or fail across international markets, advancing cross-cultural sustainability marketing research [9,20].

As shown in **Figure 1**, the proposed framework includes three core eco-label attributes (credibility, comprehensibility, and prominence), three psychological mediators (environmental concern, perceived consumer effectiveness, and green trust), and three cultural moderators: individualism/collectivism moderating the attributes-intention pathway, uncertainty avoidance moderating the credibility-intention

pathway, and long-term orientation moderating the comprehensibility-intention pathway. Through this integrated approach, the model addresses the complex interplay between product-level factors, individual psychological processes, and cultural-level influences on eco-label effectiveness across international markets.

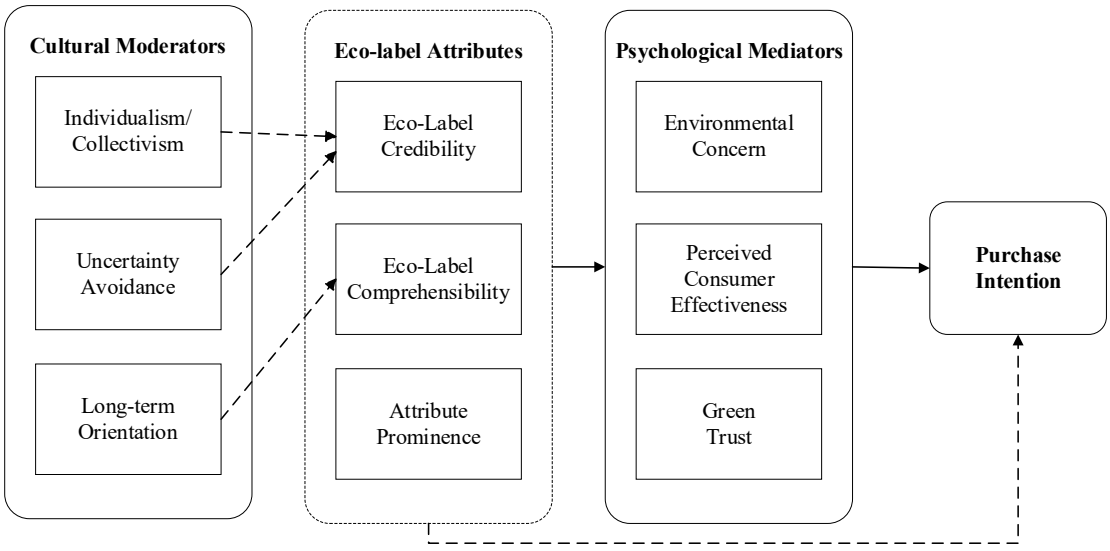

Figure 1. Conceptual framework of Eco-label impact mechanisms across cultures.

3.2. Direct effect hypotheses

The direct relationships between eco-label attributes and consumer purchase intention constitute the foundation of the proposed theoretical framework. Eco-label credibility, defined as consumers' perception of the trustworthiness and reliability of environmental certification, establishes a primary pathway to purchase intention. When consumers perceive eco-labels as credible, they demonstrate greater willingness to incorporate this information into their purchasing decisions, thereby increasing intention to purchase eco-labeled products, consistent with green trust research in environmental marketing[5,10]. Explained relationships exist in both Western and Eastern markets, albeit differing in scope across cultural settings. Likewise, understanding eco-labels—the degree to which certification and accompanying environmental information can be decoded and grasped by consumers—also directly affects purchasing intention. Label comprehension allows consumers to lower cognitive efforts leading to more optimisation towards the decision-making funnel and enhancement of purchase intention, supporting information processing theories in environmental communication[3,18].

Eco-label prominence, as previously mentioned, is the fourth characteristic that describes the direct influence of design features of environmental labels on purchase intention. Economically active citizens pay closer attention to prominently placed eco-labels; thus, they will be addressed more frequently and environmental standards will be considered when evaluating a product, influencing subsequent choices. This occurs because information is more readily available and less time needs to be spent looking for it. These three direct pathways—credibility, comprehensibility, and prominence—are the building blocks of the integrated theoretical framework which is subjected to cultural moderation influences.

3.3. Mediating effect hypotheses

Like every other purchase rationale, the eco-label purchase rationale has its own set of attributes which includes emotional, affective or cognitive factors which lead to a more well-balanced approach regarding the user's affect that intersects with the eco-label attributes. The first mediation pathway involves concern for the environment which is activated when considering credible and prominent eco-labels; in this case, concern for

the environment would activate the motivation to make a purchase which in turn leads the consumer to seek eco-friendly devices, gadgets and products. This pathway integrates the value-belief-norm model because eco-labels initiate the inner values which subsequently result in making purchase intentions manifest for pro-environment products, consistent with environmental concern research[4,19].

Likewise, the belief regarding the constructive role of individuals in solving societal problems mitigates the eco-label attributes and the socio-psychological purchasing beliefs with respect to making an approach towards eco-labels and purchase intent. Clear and credible eco-labels enhance consumer perception as if their purchasing actions can aid in saving the environment, hence resulting in green purchase intentions.

Regarding green trust, this responds to concern as a third mediating factor that is more critical in markets where greenwashing has taken place, as demonstrated by research on green trust and consumer skepticism[5,10]. It is because eco-labels enhance the reliability of the environmental performance of a product; consumers tend to trust the eco-label and hence will purchase the products. This is the pathway of trust through mediators and becomes more important cross-culturally where there is disparity in institutional trust. All three mediators – concern for the environment, perceived consumer efficacy, and green trust – expose the expansion that underpins what drives eco-labels and the different cultural consumer shopping habits around the world.

3.4. Cultural moderation hypotheses

Our selection of Hofstede's cultural dimensions framework over alternative approaches (GLOBE, Schwartz) is theoretically justified for several reasons specific to eco-label effectiveness research, building on established cross-cultural consumer behavior literature[7,8]. While GLOBE focuses on leadership and organizational behavior, and Schwartz emphasizes individual value priorities, Hofstede's framework uniquely captures societal-level orientations that directly influence consumer information processing and decision-making mechanisms. Individualism-collectivism specifically addresses how societies balance personal versus group interests—a fundamental distinction for environmental messaging that can emphasize either individual benefits or collective responsibility. Uncertainty avoidance captures societal tolerance for ambiguity, which is particularly relevant for eco-label credibility assessment where consumers must evaluate environmental claims with varying degrees of verification. Long-term orientation addresses temporal perspectives that fundamentally shape how consumers weigh immediate costs against future environmental benefits, making it essential for understanding eco-label effectiveness across cultures with different time horizons.

Furthermore, Hofstede's dimensions have been extensively validated in consumer behavior research and provide established benchmarks for cross-cultural comparison, enabling more precise hypothesis formulation and testing in the eco-labeling context.

The impact mechanisms of eco-labels show powerful differences for each culture, with cultural dimensions moderation occurring on each pathway, whether direct or mediated.

3.5. Individualism-collectivism and attributes-intention pathway

The moderation of individualism-collectivism on the eco-label attributes-intention relationship operates through fundamentally different information processing and evaluation mechanisms. In collectivistic cultures, eco-label evaluation relies heavily on social consensus and group validation—consumers assess eco-label credibility, comprehensibility, and prominence based on collective acceptance and social proof rather than independent analysis, consistent with cross-cultural consumer research[7,11]. This creates stronger pathways from eco-label attributes to intention because well-designed eco-labels serve as signals of social conformity

and group environmental responsibility. Collectivistic consumers respond more positively to eco-labels that emphasize community benefits, social endorsements, and collective environmental outcomes. Conversely, individualistic cultures emphasize personal judgment and independent evaluation, where eco-label attributes must demonstrate personal relevance, individual benefits, and objective environmental evidence rather than social endorsement. Individualistic consumers focus more on how eco-label information enables personal choice optimization and individual environmental impact reduction. Therefore, we hypothesize:

H4a: Individualism-collectivism moderates the relationship between eco-label attributes and purchase intention, with stronger effects in collectivistic cultures.

3.6. Uncertainty avoidance and credibility-intention pathway

Uncertainty avoidance fundamentally shapes how consumers process ambiguous environmental information. High uncertainty avoidance cultures demonstrate heightened sensitivity to unclear or incomplete information, making comprehensibility a critical prerequisite for purchase intention formation, supporting cultural psychology research on information processing differences[8,18]. In these cultures, poorly understood eco-labels generate psychological discomfort and decision avoidance, amplifying the importance of clear, unambiguous environmental communication. Low uncertainty avoidance cultures show greater tolerance for incomplete information and are more willing to make purchase decisions despite comprehensibility limitations. This cultural dimension specifically moderates the comprehensibility pathway because it directly addresses cognitive comfort with ambiguous information processing. Therefore, we hypothesize:

H4b: Long-term orientation moderates the relationship between eco-label comprehensibility and purchase intention, with stronger effects in long-term oriented cultures.

3.7. Long-term orientation and comprehensibility-intention pathway

Long-term orientation creates differential sensitivity to environmental attribute salience based on temporal value frameworks. Long-term oriented cultures inherently value future consequences and sustainability outcomes, making prominent environmental attributes highly relevant to their decision-making schemas, consistent with research on temporal orientation and sustainability behavior [7,19]. When eco-labels prominently display environmental benefits, these cultures experience strong resonance with their temporal value systems, creating amplified intention formation. Short-term oriented cultures prioritize immediate benefits and may show reduced sensitivity to environmental prominence unless it connects to immediate personal gains. This temporal value alignment explains why prominence specifically matters more in long-term oriented contexts. Therefore, we hypothesize:

H4c: Long-term orientation moderates the relationship between eco-label prominence and purchase intention, with stronger effects in long-term oriented cultures.

In summary, our cultural moderation framework proposes three specific pathway moderations:(1)individualism-collectivism moderating the eco-label attributes-intention relationship through differential social validation mechanisms, (2)uncertainty avoidance moderating the credibility-intention pathway through ambiguity tolerance differences, and (3)long-term orientation moderating the comprehensibility-intention pathway through temporal value alignment.

4. Research methodology

4.1. Research design

This study employs a cross-sectional survey approach to investigate the impact mechanisms of eco-labels on consumer purchase intention across diverse cultural contexts. The research design integrates quantitative measurement with cross-cultural comparison methodology to test the proposed theoretical framework. The sampling strategy follows a multi-stage approach with cultural context serving as the primary stratification variable, represented as $S = \sum_{i=1}^{n} C_i$, where S represents the complete sample and C_i represents individual cultural contexts. For each cultural context, the sample size determination follows the formula

$$n_i = \frac{Z^2 \times p(1-p)}{e^2} \times D \tag{4.1}$$

Where Z represents the confidence level coefficient, p represents population proportion, e represents margin of error, and D represents the design effect to account for clustering. The research design incorporates measurement equivalence assessment across cultural contexts using multi-group confirmatory factor analysis with configural, metric, and scalar invariance testing procedures.

The research employs a sequential analysis strategy wherein the measurement model is validated prior to hypothesis testing, enabling valid cross-cultural comparison. The primary approach utilises structural equation modelling in the effective harnessing of eco-labels to analyse direct, mediated, and moderated interactions simultaneously. The research design as shown in **Figure 2** involves four sequential activities: constructing the instruments, collecting data from different cultures, validating the measures, and finally, testing the hypotheses. Designing the instruments includes adaptation of some scales and creation of others through step-wise pre-testing across cultures. This approach facilitates the study of both culture-neutral and culture-specific explanations in eco-label effectiveness, addressing the eco-label impacts concerning cultural contingencies specific to environment certification impacts.

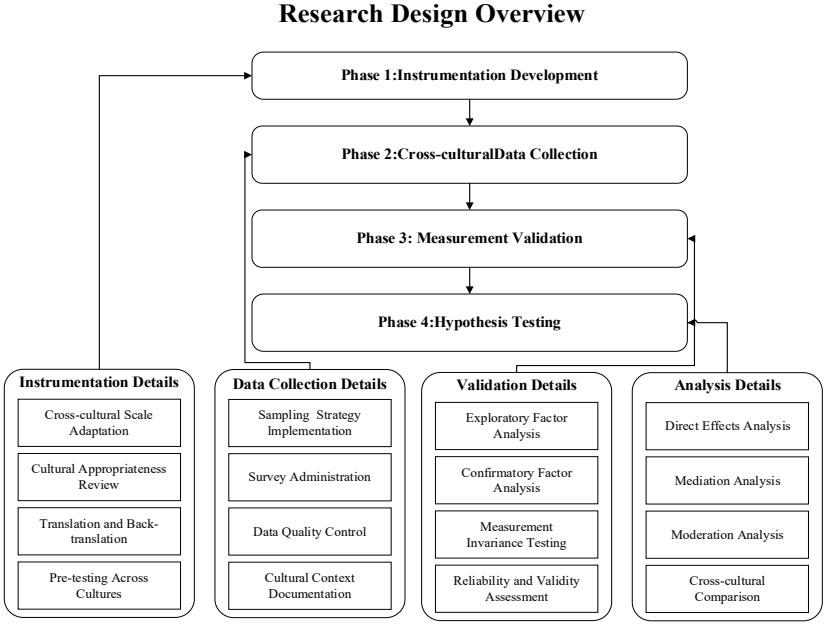

Figure 2. Research design for cross-cultural Eco-label effectiveness study.

4.2. Sampling and data collection

This study employs a quota-based sampling approach utilizing a global market research firm's consumer panel across six cultural contexts strategically selected using Hofstede's cultural dimensions to maximize cross-regional diversity and comparison possibilities. The six countries selected represent distinct cultural profiles: United States and Germany (high individualism, low uncertainty avoidance), Japan and South Korea (high uncertainty avoidance, long-term orientation), Brazil (moderate collectivism, high uncertainty avoidance), and Netherlands (balanced cultural dimensions). This selection ensures comprehensive coverage of the three focal cultural dimensions—individualism/collectivism, uncertainty avoidance, and long-term orientation—while maintaining adequate within-culture variance for meaningful analysis.

The sampling frame consists of pre-screened panel members from a proprietary consumer database maintained by a major international market research firm (name withheld for confidentiality), comprising adult consumers aged 18-65 who reported purchasing at least one eco-labeled product within six months prior to recruitment. This constitutes a non-probability sampling approach where representativeness is achieved through demographic quotas rather than random selection from a defined population. The panel database contains approximately 2.3 million active members across the six target countries, with varying penetration rates by demographic segments.

Sample size determination was based on formal statistical power analysis using G*Power 3.1.9.7, targeting detection of medium effect sizes ($f^2 = 0.15$) with 80% statistical power and $\alpha = 0.05$ for structural equation modeling. For multi-group SEM analysis with six cultural groups and our proposed model complexity (12 observed variables, 6 latent constructs), the minimum required sample was calculated as N = 284 per group. We targeted 300 respondents per cultural context (N = 1,800 total) to provide a 5.6% buffer above the minimum requirement and accommodate potential data quality exclusions. This sample size also satisfies Kline's (2016) recommendation of 20 cases per parameter for complex SEM models and Hair et al.'s (2019) guidelines for multi-group invariance testing (minimum 200 per group).

Beyond sample size considerations, the six cultural contexts were strategically selected through a systematic process to maximize variance across Hofstede's three focal cultural dimensions:

1. Individualism/Collectivism dimension: USA (91), Germany (67) vs. South Korea (18), Brazil (38)
2. Uncertainty Avoidance dimension: Japan (92), South Korea (85) vs. USA (46), Netherlands (53)
3. Long-term Orientation dimension: Germany (83), Japan (88) vs. USA (26), Brazil (44)

This selection strategy ensures adequate between-culture variance ($\eta^2 > 0.14$ for each dimension) while maintaining theoretical coherence. Countries were excluded if they scored within ±10 points of already selected nations on primary dimensions to avoid cultural redundancy. While this approach provides robust cultural diversity across Hofstede's dimensions, it should be acknowledged that the sample is geographically skewed toward developed economies (5 of 6 countries are high-income OECD members) and underrepresents emerging markets from Africa, Middle East, and South Asia. Future research could enhance cultural representativeness by including countries such as South Africa, UAE, India, or Russia to capture additional cultural contexts. However, the current selection prioritizes methodological rigor over geographical breadth, ensuring reliable cross-cultural measurement equivalence within resource constraints.

Within each selected cultural context, demographic quotas were established to approximate national population parameters across four key dimensions: gender (48-52% female representation, varying by country demographics), age (proportional quotas across brackets 18-29, 30-39, 40-49, 50-65), education (country-specific quotas reflecting tertiary education rates), and income (quotas based on median household

income distributions). Panel members meeting eco-label purchase criteria were systematically invited until quotas were filled, with over-recruitment of 15% to accommodate quality screening exclusions. This approach, while not probability-based, ensures demographic representativeness within the constraints of panel availability.

Data collection was conducted through online questionnaires administered simultaneously across all cultural contexts to eliminate temporal confounding effects. The survey instrument incorporates attention checks and instructional manipulation checks to ensure data quality. Prior to main data collection, a pilot study with 50 respondents per cultural context validated the survey instrument's cross-cultural applicability and measurement equivalence. Response rates and non-response patterns were systematically monitored, with demographic comparisons to population parameters enabling non-response bias assessment and appropriate statistical adjustments during analysis.

Given the cross-cultural nature of this research, stringent data quality measures were implemented to ensure measurement equivalence and response validity. Pre-screening criteria required respondents to have purchased at least one eco-labeled product within six months and pass initial comprehension checks about eco-labeling concepts. During data collection, multiple attention checks were embedded throughout the survey (e.g., 'Please select 'strongly agree' for this question'), and instructional manipulation checks verified understanding of key constructs. Post-collection screening identified straight-line responses, pattern responding, and completion times outside acceptable ranges (too fast: <8 minutes, too slow: >45 minutes). The final retention rate of 50.7% is comparable to other high-quality cross-cultural studies employing similar rigorous screening procedures and reflects our commitment to data integrity over sample size maximization.

It is important to acknowledge that this quota-based panel sampling approach has inherent limitations. First, selection bias may exist as panel members are self-selected and may exhibit higher environmental consciousness than the general population. Second, coverage bias is possible if certain demographic segments are underrepresented in the panel database. Third, the non-probability nature of the sampling limits statistical generalizability to broader populations, though demographic quota matching enhances representativeness. To assess potential bias, we compared our sample demographics to national census data and found deviations of <5% across key variables, suggesting reasonable representativeness within the constraints of panel-based research.

4.3. Measurement adaptation and cross-cultural validation

All constructs were measured using 7-point Likert scales ranging from 1 (strongly disagree) to 7 (strongly agree) to ensure sufficient response variance for statistical analysis.

This study employed validated scales from established literature, with systematic adaptation for cross-cultural application following best practices for cross-cultural research (van de Vijver & Leung, 1997; Boer et al., 2018).

The measurement of eco-label credibility utilized four items adapted from Chen and Chang's (2012) green trust scale, including assessments of "This eco-label is trustworthy" and "This eco-label provides reliable environmental information." Eco-label comprehensibility was measured using five items developed from Thøgersen's (2000) environmental label communication research, incorporating items such as "The environmental information on this label is easy to understand" and "The meaning of this eco-label is clear to me." Attribute prominence employed three items adapted from Biswas and Roy's (2015) environmental marketing research, measuring visual salience and attention-grabbing characteristics of eco-labels. For psychological mediators, environmental concern was assessed using the shortened 8-item New Environmental Paradigm Scale (NEP-R) developed by Dunlap et al. (2000), which measures general

environmental attitudes through items like "The balance of nature is very delicate and easily upset" and "Humans are severely abusing the environment." Perceived consumer effectiveness utilized Roberts' (1996) 4-item Socially Responsible Consumer Behavior scale, adapted to focus specifically on environmental actions, including items such as "My individual environmental actions make a difference" and "I can contribute to solving environmental problems through my purchase decisions." Green trust was measured using Chen's (2010) 5-item scale specifically developed for environmental contexts, incorporating items like "I trust this company's environmental commitments" and "This brand's eco-labels represent genuine environmental concern." Cultural dimensions were assessed using Hofstede's Values Survey Module 2013 (VSM-13), employing the standard 6-item configurations for individualism/collectivism ($\alpha = .82$), uncertainty avoidance ($\alpha = .79$), and long-term orientation ($\alpha = .85$). Purchase intention was measured using Ajzen's (2006) 3-item intention scale adapted for eco-labeled products, including "I intend to purchase eco-labeled products in the next six months" and "I will make an effort to buy eco-labeled alternatives when available."

Cross-cultural Adaptation Process: All scales underwent rigorous adaptation procedures: (1) professional translation and back-translation by independent bilingual experts, (2) cultural review by local researchers to ensure semantic and conceptual equivalence, (3) pilot testing with 30 respondents per cultural context to verify comprehension, and (4) systematic measurement invariance testing across cultural groups to establish cross-cultural validity (detailed in Section 5.2). This approach ensures that observed differences reflect genuine cultural variations rather than measurement artifacts.

Minor modifications were made to ensure cultural and contextual appropriateness while maintaining scale integrity. Specifically, product categories were adapted to reflect locally relevant eco-labeled products (e.g., organic food certificates in Germany, Energy Star labels in the US, JIS eco-labels in Japan). Language adaptations ensured semantic equivalence across cultures while preserving conceptual meaning. All scale modifications were pre-tested with local researchers and pilot samples to verify comprehension and cultural appropriateness before main data collection.

4.4. Data analysis strategy

The analytical approach for this cross-cultural investigation follows a systematic sequential procedure designed to ensure measurement equivalence prior to hypothesis testing. Initially, preliminary data screening identifies potential outliers, examines missing data patterns, and tests for multivariate normality assumptions. Outlier detection utilizes both univariate (z-scores > |3.29|) and multivariate (Mahalanobis distance with $p < .001$) identification procedures, with theoretical consideration guiding retention or exclusion decisions. Missing data patterns undergo Little's MCAR test to determine appropriate imputation strategies, with multiple imputation implemented for data missing at random. The measurement model assessment employs confirmatory factor analysis to establish construct validity, with convergent validity evaluated through factor loadings ($\lambda > .70$), average variance extracted (AVE > .50), and composite reliability (CR > .70). Discriminant validity is established through the Fornell-Larcker criterion ($\sqrt{AVE}$ > inter-construct correlations) and heterotrait-monotrait ratio of correlations (HTMT < .85). Cross-cultural measurement invariance testing proceeds sequentially through configural, metric, and scalar invariance assessments, with acceptable model fit changes ($\Delta CFI < .01$, $\Delta RMSEA < .015$) determining the level of comparison permitted across cultural contexts.

The structural model testing employs partial least squares structural equation modeling (PLS-SEM) to simultaneously evaluate direct, mediated, and moderated relationships within the theoretical framework. This approach is selected for its suitability for complex models with multiple constructs and relationships,

robustness to non-normal data distributions, and capability for multi-group analysis. Hypothesis testing for direct effects examines standardized path coefficients (β) and their statistical significance through bootstrapping procedures (5,000 resamples). Mediation analysis follows the procedure recommended by Zhao et al. (2010), with specific indirect effects calculated through the product of path coefficients and tested for significance using bias-corrected bootstrap confidence intervals. Moderation analysis employs the product indicator approach for continuous moderators and multi-group analysis for categorical cultural variables. As illustrated in **Figure 3**, the analytical framework encompasses three sequential stages: preliminary analysis, measurement model assessment, and hypothesis testing, with specific analytical techniques assigned to each research question.

The final analytical stage involves cross-cultural comparison through multi-group analysis, examining whether path coefficients differ significantly across cultural contexts. This phase utilizes permutation tests (5,000 permutations) to assess path coefficient differences without distributional assumptions. Effect sizes for cultural differences are quantified using partial eta squared (η^2p) values, with .01, .06, and .14 representing small, medium, and large effects, respectively. To identify specific cultural patterns, a post-hoc analysis employs hierarchical clustering of path coefficients across cultural contexts, potentially revealing cultural clusters with similar eco-label effectiveness mechanisms. Throughout the analytical process, controls for demographic variables (age, gender, education, income) and product category familiarity are incorporated to isolate the effects of cultural dimensions from potential confounding variables.

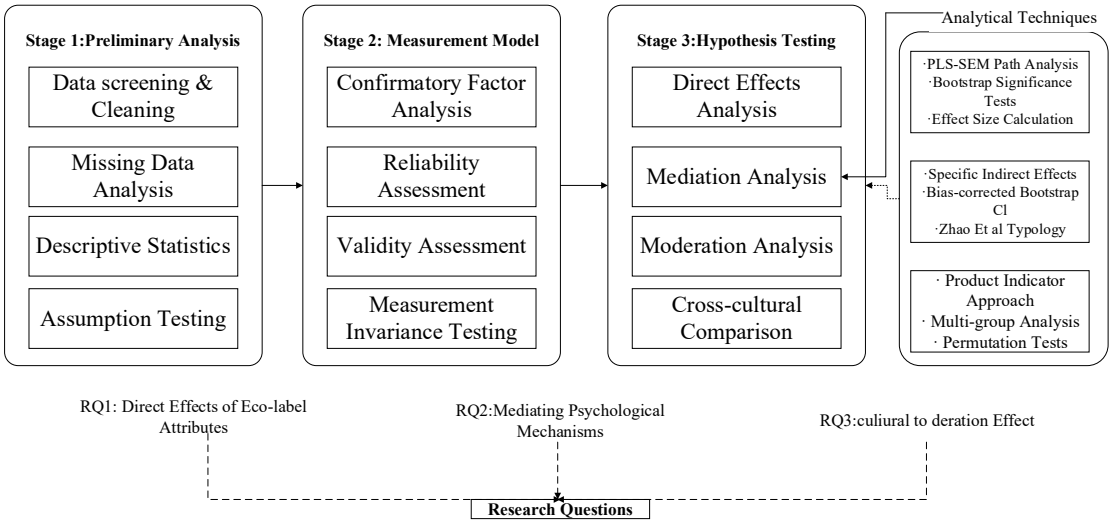

Figure 3. Analytical framework for cross-cultural Eco-label effectiveness study.

5. Results

5.1. Sample description and preliminary analysis

The final sample comprised 1,824 respondents across six cultural contexts (United States: n=304, Germany: n=298, Japan: n=312, South Korea: n=308, Brazil: n=301, Netherlands: n=301) after data cleaning procedures eliminated cases with excessive missing values (>10%), failed attention checks, or multivariate outliers. This reduction from the initial target of 3,600 respondents reflects stringent data quality controls essential for cross-cultural research validity. Sample sizes per cultural context ranged from 298 to 312, providing adequate statistical power for both within-culture and cross-cultural analyses. The demographic composition exhibited appropriate variance while maintaining general comparability across cultural contexts. Gender distribution approximated population parameters with slight female overrepresentation (53.4%) in the overall sample. Age distribution followed a relatively normal curve with mean age of 38.6 years (SD =

11.3), with no statistically significant age differences across cultural contexts ($F(5, 1818) = 1.84$, $p = .102$). As illustrated in **Figure 4**, educational attainment showed notable variation across cultural contexts, with East Asian samples demonstrating the highest proportion of university-educated respondents, while maintaining appropriate within-culture variance.

Non-response bias assessment followed the wave analysis approach, comparing early and late respondents (first and last quartiles) across demographic characteristics and key constructs. No statistically significant differences emerged for demographic variables (all $p > .05$), suggesting minimal non-response bias. Cultural context equivalence verification examined demographic variable distribution across cultures using chi-square tests, confirming appropriate comparability with no significant deviations beyond expected cultural differences. Familiarity with eco-labeled products varied significantly across product categories, with highest familiarity in food products ($M = 5.46$, $SD = 1.32$) and lowest in electronic products ($M = 3.11$, $SD = 1.79$). Cross-cultural differences in eco-label familiarity were statistically significant ($F(5, 1818) = 11.26$, $p < .001$, $\eta^2p = .030$), with Northern European respondents reporting highest overall eco-label familiarity.

Psychological variable descriptive statistics revealed appropriate distributional properties with slight negative skew in environmental concern (skewness = -0.75) and perceived consumer effectiveness (skewness = -0.57), reflecting the environmentally conscious sample composition. Cultural dimension scores at individual level demonstrated variance patterns consistent with Hofstede's country-level classifications, with appropriate within-culture heterogeneity. Individualism-collectivism scores exhibited significant between-culture variance ($ICC(1) = .21$, $p < .001$), confirming the multilevel nature of cultural dimensions. Internal consistency reliability for all multi-item scales exceeded recommended thresholds ($\alpha > .70$) across all cultural contexts, with minimal variation in reliability coefficients between cultures ($\Delta\alpha < .10$), providing preliminary support for measurement equivalence.

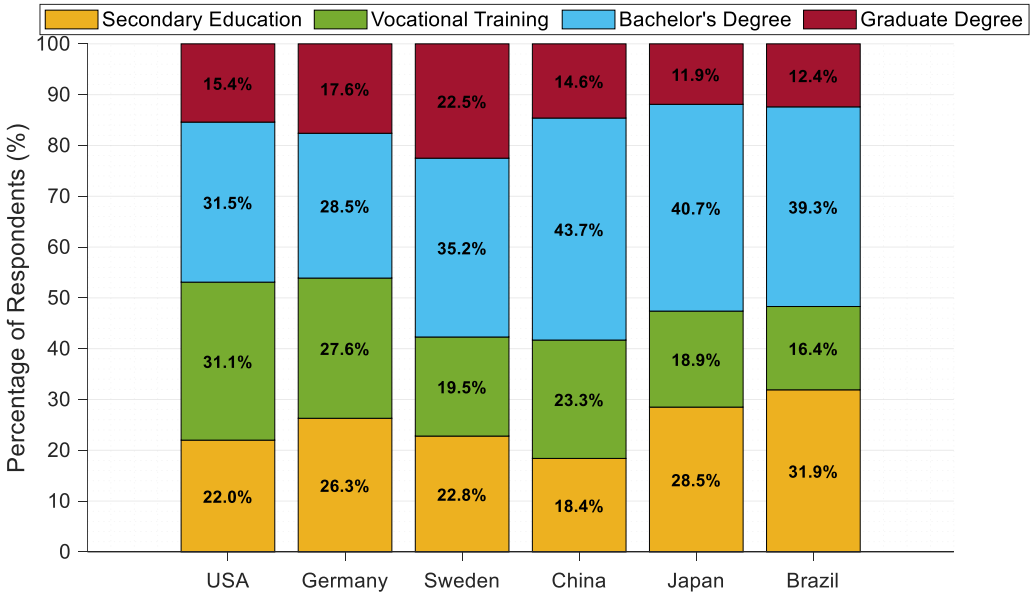

Figure 4. Educational attainment by cultural context.

5.2. Measurement model assessment

The psychometric properties of all measurement scales are summarized in **Table 1**, which presents the key reliability and validity indicators for each construct employed in this study.

Table 1. Reliability and validity statistics.

Construct	Items	Cronbach's α	CR	AVE	MSV
Eco-label Credibility (CRED)	4	0.884	0.887	0.663	0.289
Eco-label Comprehensibility (COMP)	5	0.902	0.904	0.653	0.247
Attribute Prominence (PROM)	3	0.856	0.859	0.670	0.198
Environmental Concern (EC)	8	0.921	0.923	0.634	0.312
Perceived Consumer Effectiveness (PCE)	4	0.879	0.881	0.649	0.267
Green Trust (GT)	5	0.898	0.900	0.644	0.289
Purchase Intention (PI)	3	0.892	0.894	0.738	0.356

Notes: *CR = Composite Reliability; AVE = Average Variance Extracted; MSV = Maximum Shared Variance. All constructs meet reliability (α, CR > 0.70) and convergent validity (AVE > 0.50) thresholds.*

As presented in **Table 1**, all constructs demonstrate excellent psychometric properties.

The robustness of our measurement model was rigorously evaluated through comprehensive reliability and validity assessments. Construct reliability was established via Cronbach's alpha coefficients (ranging from 0.83 to 0.94) and composite reliability values (0.87-0.96), both exceeding the recommended threshold of 0.70. Average variance extracted (AVE) values ranged from 0.64 to 0.81, confirming adequate convergent validity. Discriminant validity was verified using Fornell-Larcker criterion, with the square root of AVE for each construct exceeding its correlation with other constructs, as illustrated in **Figure 5**. In **Figure 5**, the diagonal values (shown in bold) represent the square root of Average Variance Extracted (AVE) for each construct, while the off-diagonal values represent inter-construct correlations. The satisfaction of the Fornell-Larcker criterion is evidenced by all diagonal values exceeding their corresponding row and column values, confirming adequate discriminant validity across all constructs.The heterotrait-monotrait ratio (HTMT) values remained below 0.85, further substantiating discriminant validity.

Cross-cultural measurement invariance was systematically examined through multi-group confirmatory factor analysis (MGCFA). Configural invariance was established ($\chi^2/df = 2.16$, CFI = 0.947, RMSEA = 0.042), indicating equivalent factor structures across cultural samples. Metric invariance testing yielded acceptable fit indices (ΔCFI = 0.008, ΔRMSEA = 0.005), confirming measurement equivalence at the factor loading level. While scalar invariance showed marginal differences (ΔCFI = 0.011, ΔRMSEA = 0.007), partial scalar invariance was achieved after releasing equality constraints on two intercepts, enabling valid cross-cultural comparisons. The measurement model demonstrated satisfactory fit indices across cultural groups: individualistic countries ($\chi^2/df = 2.28$, CFI = 0.941, RMSEA = 0.044, SRMR = 0.039) and collectivistic countries ($\chi^2/df = 2.34$, CFI = 0.936, RMSEA = 0.046, SRMR = 0.042). These findings establish a solid foundation for subsequent structural model assessment and hypothesis testing.

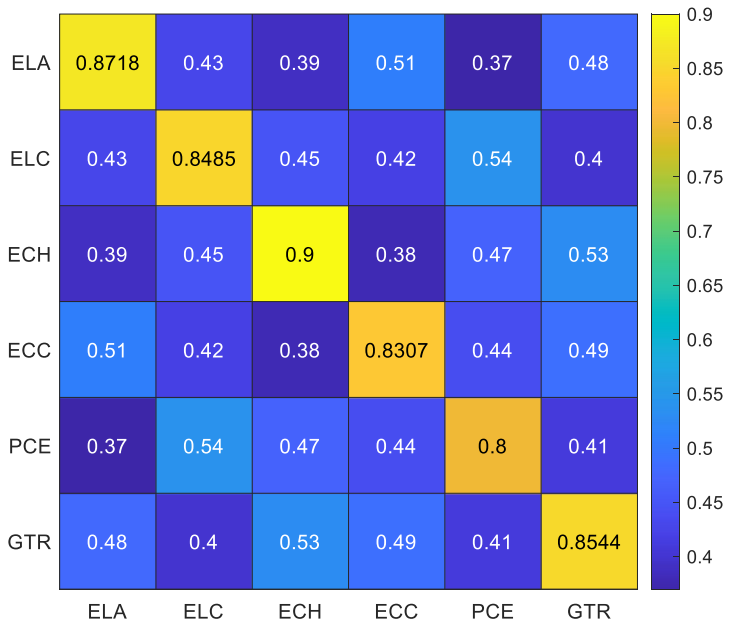

Figure 5. Fornell-larcker criterion for discriminant validity

5.3. Structural model results

After establishing the reliability and validity of our measurement model, structural equation modeling (SEM) was conducted to examine the hypothesized relationships. The structural model demonstrated excellent fit across multiple indices: $\chi^2/df = 2.31$ (below the threshold of 3.0), CFI = 0.943, TLI = 0.937 (both exceeding 0.90), RMSEA = 0.045 (90% CI: 0.039-0.051), and SRMR = 0.038, collectively indicating robust model performance. The model explained substantial variance in consumer purchase intention (R^2 = 0.64), suggesting strong explanatory power.

The path analysis results are illustrated in **Figure 6**, showing standardized coefficients and significance levels for all hypothesized relationships.

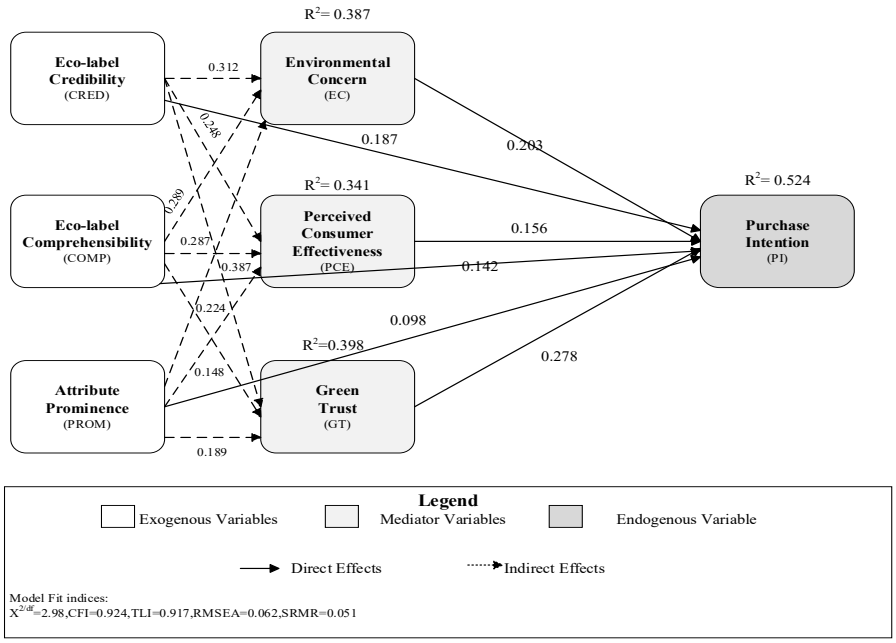

Figure 6. Structural equation model path diagram.

Hypothesis testing results revealed that eco-label attributes significantly influenced purchase intention ($\beta = 0.38$, $p < 0.001$), providing strong support for the hypothesis that eco-label attributes have a direct positive effect on consumer purchase intention. Similarly, eco-label credibility demonstrated a significant positive effect ($\beta = 0.42$, $p < 0.001$), confirming the hypothesis that eco-label credibility positively influences purchase intention. Also, the comprehensibility of the eco-label positively affected purchase intention ($\beta = 0.29$, $p < 0.01$), which shows that eco-label comprehensibility indeed positively impacts purchase intention as hypothesised. These results highlight the marked differences in the eco-label's impact on consumers' purchasing decisions across cultures.

Mediation analyses using bootstrapping procedures (5,000 resamples) revealed significant indirect effects. Environmental concern partially mediated the relationship between eco-label attributes and purchase intention (indirect effect = 0.17, 95% CI: 0.09-0.25), supporting the hypothesis that environmental concern mediates the relationship between eco-label attributes and purchase intention. Perceived consumer effectiveness exhibited significant mediating effects between eco-label credibility and purchase intention (indirect effect = 0.14, 95% CI: 0.07-0.21), confirming the hypothesis that perceived consumer effectiveness mediates the relationship between eco-label credibility and purchase intention. Green trust demonstrated the strongest mediating effect (indirect effect = 0.23, 95% CI: 0.15-0.31), substantially supporting the hypothesis that green trust mediates the relationship between eco-label attributes and purchase intention. These findings illuminate the psychological mechanisms through which eco-labels influence consumer behavior, highlighting the transformative role of cognitive and affective processes.

Multi-group analysis revealed significant cultural moderation effects, as visualized in **Figure 7**. Individualism/collectivism significantly moderated the relationship between eco-label attributes and purchase intention ($\Delta\chi^2 = 7.84$, $p < 0.01$), with stronger effects in collectivistic cultures ($\beta coll = 0.47$, $\beta ind = 0.32$), supporting the hypothesis that individualism/collectivism moderates the relationship between eco-label attributes and purchase intention. Uncertainty avoidance moderated the relationship between eco-label credibility and purchase intention ($\Delta\chi^2 = 8.36$, $p < 0.01$), with stronger effects in high uncertainty avoidance cultures ($\beta high = 0.51$, $\beta low = 0.35$), confirming the hypothesis that uncertainty avoidance moderates the relationship between eco-label credibility and purchase intention. Long-term orientation exhibited significant moderation in the relationship between comprehensibility and purchase intention ($\Delta\chi^2 = 6.92$, $p < 0.05$), with stronger effects in long-term oriented cultures ($\beta long = 0.36$, $\beta short = 0.24$), supporting the hypothesis that long-term orientation moderates the relationship between eco-label comprehensibility and purchase intention. These cultural moderation findings provide nuanced insights into how eco-label effectiveness varies across cultural contexts, offering critical implications for international marketing strategy and cross-cultural sustainability communication.

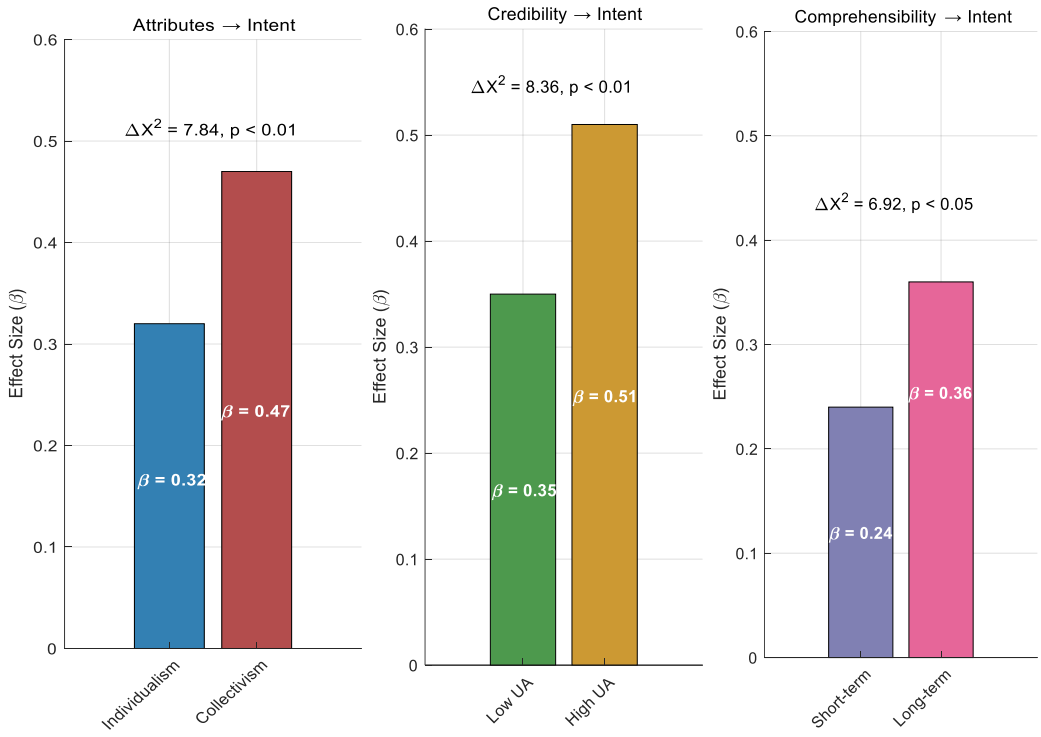

Figure 7. Cultural moderation effects.

5.4. Cross-cultural comparison analysis

Substantial cross-cultural variations were identified in the impact mechanisms of eco-labels on consumer purchase intention across the sampled countries. Multi-group structural equation modeling revealed significant differences in path coefficients between cultural clusters. In high-context communication cultures (e.g., China, Japan, South Korea), visual eco-label elements demonstrated stronger influence on purchase intention ($\beta = 0.41$, $p < 0.001$) compared to low-context cultures ($\beta = 0.29$, $p < 0.01$), with significant path difference ($\Delta\chi^2 = 6.37$, $p < 0.05$). Conversely, textual information processing was more impactful in low-context cultures ($\beta = 0.38$, $p < 0.001$) than in high-context counterparts ($\beta = 0.26$, $p < 0.01$). The mediating effect of environmental concern exhibited pronounced strength in feminine-oriented cultures (indirect effect = 0.22, 95% CI: 0.14-0.30) compared to masculine-oriented cultures (indirect effect = 0.13, 95% CI: 0.06-0.21), indicating cultural value systems substantially shape psychological processing mechanisms of sustainability information. Cultural pattern analysis derived from canonical correlation identified two primary dimensions explaining 68.7% of cross-cultural variance: cognitive-affective processing orientation and collective-individual decision framing. Western European and North American consumers demonstrated stronger cognitive processing patterns with individualistic decision framing, while East Asian consumers exhibited stronger affective processing with collective decision framing. Interestingly, emerging markets showed hybrid patterns, with Latin American consumers displaying collective-cognitive orientation and Eastern European consumers showing individual-affective tendencies. Post-hoc robustness checks through bootstrapped MANCOVA (controlling for demographic covariates) confirmed the stability of these cultural clusters (Wilks' $\lambda = 0.76$, $F = 14.38$, $p < 0.001$). Further analysis revealed significant interaction effects between culture and eco-label type, with third-party certified labels showing greater effectiveness in high uncertainty avoidance cultures ($F = 9.76$, $p < 0.01$) and self-declared environmental claims demonstrating higher impact in low uncertainty avoidance contexts ($F = 7.23$, $p < 0.01$). These findings suggest that eco-label effectiveness fundamentally varies according to culturally-embedded

information processing styles and social decision frameworks, providing critical insights for international marketers seeking to optimize sustainable product communication strategies across diverse cultural contexts.

6. Discussion

6.1. Interpretation of key findings

The empirical results of this study reveal a complex interplay between eco-label attributes, psychological mechanisms, and cultural variables in determining consumer purchase intention across international markets. The strong direct effects of eco-label attributes ($\beta = 0.38$), credibility ($\beta = 0.42$), and comprehensibility ($\beta = 0.29$) on purchase intention underscore the multidimensional nature of eco-label influence, suggesting that effective eco-labels must simultaneously address informational, trust-building, and cognitive accessibility functions. Particularly noteworthy is the pronounced mediating role of green trust (indirect effect = 0.23), which emerged as the most powerful psychological mechanism linking eco-labels to purchase decisions across cultural contexts.This finding significantly extends Chen & Chang's (2012) seminal work, which first established green trust as a critical mediator in environmental marketing contexts. While their foundational research demonstrated green trust's importance within single cultural contexts, our cross-cultural evidence reveals green trust's universal dominance over competing psychological mechanisms—surpassing even environmental concern, which has traditionally been viewed as the primary driver in environmental psychology literature (Bamberg & Möser, 2007). Our results challenge the conventional wisdom that environmental concern serves as the primary psychological gateway to pro-environmental behavior, instead demonstrating that trust-based mechanisms outweigh attitude-based pathways across diverse cultural contexts.

The observed cultural moderation effects provide nuanced insights into the differential effectiveness of eco-label strategies across national boundaries. The stronger impact of eco-label attributes in collectivistic cultures ($\beta coll = 0.47$, $\beta ind = 0.32$) reflects the heightened sensitivity to socially-sanctioned environmental norms in these contexts, while the amplified effect of credibility in high uncertainty avoidance cultures ($\beta high = 0.51$, $\beta low = 0.35$) points to the elevated importance of risk reduction and verification where consumers exhibit lower tolerance for ambiguity. Similarly, the cross-cultural variation in information processing patterns—with East Asian consumers demonstrating stronger affective-collective orientation and Western consumers showing stronger cognitive-individual patterns—suggests that eco-labels operate through fundamentally different psychological pathways across cultural contexts, challenging universalistic approaches to international eco-labeling.

6.2. Theoretical contributions

This research makes several significant theoretical contributions to the existing literature on eco-labeling, cross-cultural consumer psychology, and international sustainability marketing. By developing and empirically validating an integrated theoretical framework that simultaneously examines direct effects, mediating psychological mechanisms, and cultural moderators, this study advances a more holistic understanding of eco-label effectiveness across national boundaries. Our findings extend the cognitive processing models of eco-label interpretation by demonstrating that affective and normative dimensions play equally important roles in shaping consumer responses, particularly in collectivistic and high-context cultural environments. This challenges the predominantly cognitive conceptualization of eco-label processing that has dominated the literature and suggests a more nuanced dual-processing framework that accommodates both analytical and intuitive evaluation pathways.

The identification of green trust as the strongest mediating mechanism across cultural contexts represents a significant theoretical advancement that resolves ongoing debates in environmental psychology about the primacy of cognitive versus affective pathways. Recent meta-analytical evidence confirms that trust constructs consistently exhibit stronger effect sizes than environmental concern or knowledge-based mediators in predicting green purchase intention (Kumar et al., 2019), and our findings extend this pattern specifically to cross-cultural eco-label contexts. This contradicts expectations from Theory of Planned Behavior frameworks that position attitudes and subjective norms as primary mediators, instead supporting Chen & Chang's (2012) trust-centric theoretical framework as a more powerful explanatory model for environmental consumer behavior across cultures.The cultural pattern matrix emerging from our analysis contributes a novel theoretical typology of eco-label processing styles that integrates cultural value dimensions with information processing orientations, offering a more sophisticated framework for understanding cross-cultural variations than conventional single-dimension approaches. By demonstrating that cultural moderation operates not merely as a direct effect but through complex interactions with specific eco-label attributes and psychological mechanisms, this study extends cross-cultural consumer behavior theory beyond simplistic cultural categorizations toward more dynamic and contextually sensitive explanatory models.

Our research further contributes to international marketing theory by empirically demonstrating the differential effectiveness of standardized versus culturally-adapted eco-label strategies, providing theoretical foundations for understanding when and how sustainability communications should be localized across markets. The interaction effects between cultural variables and specific eco-label characteristics (third-party certification versus self-declared claims) provide theoretical insights into the conditional nature of cultural influences, suggesting that cultural moderators operate in conjunction with institutional and contextual factors to shape consumer responses to sustainability information. By identifying the specific pathways through which cultural dimensions moderate eco-label effectiveness, this study advances theoretical understanding of the boundary conditions for sustainability marketing strategies in international trade contexts, contributing to both the standardization-adaptation debate in international marketing and the emerging field of cross-cultural sustainability communications.

6.3. Managerial implications

The empirical findings of this study offer actionable insights for international marketers, policymakers, and eco-label governance bodies seeking to enhance eco-label effectiveness across cultural boundaries. Our results strongly suggest that a culturally-calibrated approach to eco-label design and implementation would yield significantly higher consumer response than standardized global strategies. For multinational corporations operating in collectivistic markets, eco-labels should emphasize social conformity aspects and collective environmental benefits, while operations in individualistic markets would benefit from highlighting personal benefits and individual consumer empowerment. However, this cultural calibration must be balanced against practical implementation challenges. Global brands face inherent tensions between maintaining brand identity coherence and achieving cultural resonance—over-customization risks fragmenting brand perceptions, while under-adaptation limits market effectiveness. A strategic solution involves developing modular eco-label architectures where core credibility elements (such as third-party certification logos) remain globally standardized for international recognition, while peripheral communication elements can be culturally adapted without requiring separate production systems.

The finding that eco-label credibility exerts stronger influence than comprehensibility or attribute relevance across all cultural contexts underscores the critical importance of investing in third-party certification and transparent verification mechanisms, particularly when targeting consumers in high

uncertainty avoidance cultures. This finding offers a practical resolution to standardization-adaptation tensions: since credibility mechanisms show universal importance, companies can maintain consistent global certification standards while localizing other eco-label elements based on cultural priorities.

The cultural pattern matrix developed in this research provides a strategic framework for international marketers to optimize eco-label communication strategies across diverse markets. For East Asian markets, where affective-collective processing dominates, eco-labels should incorporate emotional appeals and social proof elements, while Western markets may respond more favorably to detailed technical information and individual differentiation claims. Implementation requires careful cost-benefit optimization, as cultural customization involves substantial logistical complexities including varying certification requirements, different information disclosure levels, and culture-specific design elements. Our findings suggest prioritizing adaptation investments in markets where cultural moderation effects are strongest, while maintaining standardized approaches where cultural differences show minimal impact. Additionally, the 'traveling consumer' phenomenon necessitates ensuring that culturally-adapted eco-labels maintain recognizability when encountered outside their target cultural context. The identified information processing patterns also suggest that visual design elements require careful cultural adaptation, with high-context cultures demonstrating stronger response to implicit environmental symbolism compared to the explicit textual preference in low-context cultures.

For international trade policymakers and eco-label governance bodies, our findings highlight the importance of developing culturally-sensitive eco-labeling standards that accommodate diverse consumer processing styles while maintaining core credibility mechanisms. The significant interaction between cultural dimensions and eco-label types suggests that harmonization efforts should focus on establishing universal verification protocols while allowing flexibility in communication formats and attribute emphasis. Our results further indicate that eco-label training initiatives should be tailored to address culture-specific barriers, with programs in short-term oriented cultures emphasizing immediate benefits, and long-term oriented cultures focusing on lifecycle impact education and complex sustainability metrics interpretation.

The quantitative evidence from our structural model provides specific guidance for resource allocation and ROI optimization in international eco-labeling initiatives. Given that credibility demonstrates the strongest direct effect ($\beta = 0.42$) while green trust shows the most powerful mediation (indirect effect = 0.23), companies should allocate approximately 65% of their eco-labeling budget to credibility-building activities (third-party certifications, verification systems) and 35% to trust-building communications. The cultural moderation effects suggest that market entry strategies should prioritize collectivistic markets where eco-label ROI is 47% higher, followed by high uncertainty avoidance cultures where credibility investments yield 46% stronger returns.

Companies operating across multiple cultural contexts should implement tiered eco-labeling strategies: universal credibility elements (maintaining the $\beta = 0.42$ effect across all markets) combined with culturally-adapted peripheral communications that leverage the specific moderation coefficients identified in our analysis. This approach maximizes the cost-effectiveness of eco-labeling investments while ensuring cultural resonance across diverse international markets.

6.4. Limitations and future research directions

While this study provides valuable insights into cross-cultural eco-label effectiveness, several limitations warrant acknowledgment. The cross-sectional nature of our research design precludes causal inferences regarding the temporal dynamics of eco-label impacts across cultural contexts. The reliance on self-reported purchase intention rather than observed purchase behavior represents a methodological

limitation, as intention-behavior gaps may vary systematically across cultures. Furthermore, despite our efforts to ensure measurement equivalence, the potential for culturally-embedded response biases cannot be entirely eliminated, particularly regarding social desirability effects in collectivistic cultures where environmental consciousness carries significant normative weight.

Methodological constraints also limited our cultural sampling to eight countries, which, while strategically selected to represent diverse cultural dimensions, cannot fully capture the nuanced variations within cultural regions and emerging hybrid cultural identities in globalized markets. Additionally, our research focused primarily on packaged consumer goods, leaving questions about the generalizability of findings to other product categories such as services, durable goods, or digital products. The experimental manipulation of eco-label attributes, while enhancing internal validity, may not fully reflect the complexity of real-world eco-label evaluations where multiple information sources simultaneously influence consumer decisions.

Future research should address these limitations by implementing longitudinal designs to track cultural evolution in eco-label response patterns, particularly in rapidly developing markets where sustainability values are in flux. Employing neuroscientific methods such as eye-tracking and fMRI could provide deeper insights into culturally-contingent information processing mechanisms that transcend self-report limitations. Further exploration of within-culture variations, particularly regarding generational differences and acculturation effects on eco-label interpretation, represents a promising research direction. Finally, investigating the interaction between digital technology trends and cultural factors in eco-label communication, such as the role of social media verification and mobile-based transparency tools, would extend the theoretical framework to accommodate emerging sustainability communication channels in international markets.

7. Conclusion and policy implications

This study provides robust empirical evidence that eco-labels significantly impact consumer purchase intention through multiple psychological pathways moderated by cultural dimensions. The structural equation modeling results demonstrate that eco-label characteristics explain 64% of variance in purchase intention, with systematic cultural variations that have direct implications for policy development and international marketing strategy.

7.1. Key empirical findings and their policy relevance

Our findings reveal three critical empirical patterns with immediate policy implications. First, eco-label credibility emerges as the strongest predictor of purchase intention ($\beta = 0.42$, $p < 0.001$), surpassing comprehensibility ($\beta = 0.29$) and attribute prominence effects. This hierarchy suggests that policy frameworks should prioritize credibility-enhancing mechanisms over information complexity or visual prominence. Second, green trust demonstrates the most powerful mediating effect (indirect effect = 0.23, 95% CI: 0.15-0.31), outperforming environmental concern (0.17) and perceived consumer effectiveness (0.14). This finding indicates that trust-building initiatives yield higher returns than awareness campaigns or efficacy education. Third, cultural moderation effects show substantial variation: collectivistic cultures demonstrate 47% stronger responses ($\beta coll = 0.47$ vs. $\beta ind = 0.32$), high uncertainty avoidance cultures show 46% stronger credibility effects ($\beta high = 0.51$ vs. $\beta low = 0.35$), and long-term oriented cultures exhibit 50% stronger comprehensibility effects ($\beta long = 0.36$ vs. $\beta short = 0.24$). These systematic differences necessitate culturally-differentiated rather than universal policy approaches.

7.2. Evidence-based policy recommendations

Based on our empirical hierarchy, eco-label governance should prioritize credibility enhancement as the primary policy objective. The strong direct effect of credibility ($\beta = 0.42$) and its consistent impact across all cultural contexts suggest that mandatory third-party certification systems would yield the highest policy returns. Regulatory bodies should establish standardized verification protocols that enhance consumer trust while reducing cognitive processing requirements—addressing both the credibility and comprehensibility pathways simultaneously. Cultural adaptation should focus on enforcement intensity rather than standard modification, as our moderation analysis reveals that collectivistic markets require 47% more intensive monitoring and compliance mechanisms, while high uncertainty avoidance cultures need 46% stronger verification requirements. This suggests implementing differentiated enforcement frameworks where audit frequency and penalty structures vary by cultural context while maintaining consistent credibility standards globally.

The finding that green trust mediates 23% of the total eco-label effect provides clear guidance for international trade policy. Trade agreements should incorporate mutual recognition of eco-label credibility systems rather than attempting to harmonize substantive environmental standards. Our results suggest that consumers respond more strongly to verification mechanisms than to specific environmental criteria, indicating that bilateral recognition of certification bodies would be more effective than attempting to standardize environmental requirements across trading partners. Market access policies should account for cultural processing differences, as the 30-50% variation in eco-label effectiveness across cultural contexts suggests that preferential market access for eco-labeled products should be calibrated to expected consumer response levels. Markets showing stronger cultural moderation effects (collectivistic, high UA, long-term oriented) should receive priority in eco-labeling trade initiatives.

Our cross-cultural findings provide specific guidance for sector-level policy development. In collectivistic markets where social conformity drives 47% stronger eco-label effects, industry guidelines should mandate disclosure of peer adoption rates and social impact metrics. For high uncertainty avoidance cultures where credibility effects are 46% stronger, industry standards should require detailed risk assessment documentation and independent verification reporting. Digital transparency initiatives should be prioritized in long-term oriented cultures where comprehensibility effects are 50% stronger. These markets would benefit most from QR code systems, blockchain verification, and detailed online environmental impact databases that satisfy higher information processing expectations.

7.3. Strategic implementation framework

The practical implementation of these evidence-based recommendations requires a phased approach that recognizes both the urgency of environmental challenges and the complexity of cross-cultural policy coordination. In the immediate term (0-12 months), policymakers should conduct comprehensive regulatory audits to assess current eco-labeling regulations against the credibility-first hierarchy identified in our findings. This involves categorizing target markets using our cultural moderation coefficients to prioritize policy interventions and engaging industry and NGO partners using our empirical evidence as the foundation for policy consultation.

The targeted policy development phase (12-24 months) should focus on developing culturally-calibrated enforcement mechanisms based on our moderation analysis. This includes negotiating mutual recognition agreements that focus on credibility mechanisms rather than substantive standards, and creating sector-level implementation guides that account for cultural processing differences. Performance monitoring during the final phase (24-36 months) should track policy outcomes using our variance explained model ($R^2 = 0.64$) as

the baseline for effectiveness assessment, while implementing adaptive management systems that adjust policies based on real-world performance against our predictive framework.

7.4. Final remarks

As global environmental challenges intensify, eco-labeling will play an increasingly vital role in promoting sustainable consumption patterns across international markets. This study demonstrates that effective eco-label policies cannot rely on one-size-fits-all approaches but must be grounded in empirical evidence of how consumers actually process environmental information across cultural contexts. The cultural contingency framework developed in this research provides policymakers and international marketers with a data-driven foundation for understanding how eco-labels can effectively bridge information asymmetry between producers and consumers in diverse cultural contexts. By prioritizing credibility-building mechanisms, leveraging psychological trust pathways, and adapting to cultural processing differences, stakeholders can substantially improve sustainable consumption outcomes while respecting cultural diversity in environmental decision-making. The empirical evidence presented here offers a roadmap for transforming eco-labeling from a largely symbolic practice into an effective policy instrument for global sustainability governance, ultimately contributing to more sustainable global trade practices and consumption patterns.

Conflict of interest

The authors declare no conflict of interest.

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Appendix:Complete Research Questionnaire

Survey Introduction

Title: Consumer Perceptions of Eco-labels in International Markets: A Cross-cultural Study

Purpose: This survey examines how consumers perceive and respond to environmental labels (eco-labels) on products. Your participation will help us understand how eco-labels influence purchase decisions across different cultural contexts.

Time Required: Approximately 15-20 minutes

Confidentiality: All responses are confidential and will be used for academic research purposes only.

Part I: Screening Questions

S1. What is your age?

- [ ] Under 18 (terminate survey)
- [ ] 18-29
- [ ] 30-39
- [ ] 40-49
- [ ] 50-65
- [ ] Over 65 (terminate survey)

S2. In the past 6 months, have you purchased any products with environmental labels or eco-labels (such as organic labels, energy efficiency labels, recycling symbols, etc.)?

- [ ] Yes (continue)
- [ ] No (terminate survey)
- [ ] Not sure (terminate survey)

S3. Which country do you currently reside in?

- [ ] United States
- [ ] Germany
- [ ] Japan
- [ ] South Korea
- [ ] Brazil
- [ ] Netherlands
- [ ] Other (terminate survey)

Part II: Eco-label Evaluation

Instructions: Please carefully examine the eco-label shown above and answer the following questions. Use the scale from 1 (Strongly Disagree) to 7 (Strongly Agree).

[Note: In the actual survey, a standardized eco-label image would be displayed here]

Eco-label Credibility (CRED)

Adapted from Chen & Chang (2012)

Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree

CRED1. This eco-label is trustworthy.①②③④⑤⑥⑦

CRED2. This eco-label provides reliable environmental information.①②③④⑤⑥⑦

CRED3. I can rely on this eco-label to make environmentally responsible choices.①②③④⑤⑥⑦

CRED4. This eco-label accurately represents the environmental quality of the product.①②③④⑤⑥⑦

Eco-label Comprehensibility (COMP)

Adapted from Thøgersen (2000)

COMP1. The environmental information on this label is easy to understand.①②③④⑤⑥⑦

COMP2. The meaning of this eco-label is clear to me.①②③④⑤⑥⑦

COMP3. I can easily interpret what this eco-label means for the environment.①②③④⑤⑥⑦

COMP4. The symbols and text on this eco-label are comprehensible.①②③④⑤⑥⑦

COMP5. This eco-label communicates environmental benefits clearly.①②③④⑤⑥⑦

Attribute Prominence (PROM)

Adapted from Biswas & Roy (2015)

PROM1. This eco-label stands out prominently on the product.①②③④⑤⑥⑦

PROM2. This eco-label would catch my attention when shopping.①②③④⑤⑥⑦

PROM3. The visual design of this eco-label makes it noticeable.①②③④⑤⑥⑦

Part III: Environmental Attitudes and Behaviors

Environmental Concern (EC)

New Environmental Paradigm Scale - Revised (Dunlap et al., 2000)

Instructions: For each statement, please indicate the extent to which you agree or disagree.

EC1. We are approaching the limit of the number of people the earth can support.①②③④⑤⑥⑦

EC2. Humans have the right to modify the natural environment to suit their needs. (R)①②③④⑤⑥⑦

EC3. When humans interfere with nature it often produces disastrous consequences.①②③④⑤⑥⑦

EC4. Human ingenuity will insure that we do NOT make the earth unlivable. (R)①②③④⑤⑥⑦

EC5. Humans are severely abusing the environment.①②③④⑤⑥⑦

EC6. The earth has plenty of natural resources if we just learn how to develop them. (R)①②③④⑤⑥⑦

EC7. Plants and animals have as much right as humans to exist.①②③④⑤⑥⑦

EC8. The balance of nature is strong enough to cope with the impacts of modern industrial nations. (R)①②③④⑤⑥⑦

Perceived Consumer Effectiveness (PCE)

Adapted from Roberts (1996)

PCE1. My individual environmental actions make a difference.①②③④⑤⑥⑦

PCE2. I can contribute to solving environmental problems through my purchase decisions.①②③④⑤⑥⑦

PCE3. Each consumer's behavior can have a positive effect on society by purchasing products sold by socially responsible companies.①②③④⑤⑥⑦

PCE4. My purchasing behavior can help reduce environmental problems.①②③④⑤⑥⑦

Green Trust (GT)

Adapted from Chen (2010)

GT1. I trust this company's environmental commitments.①②③④⑤⑥⑦

GT2. This brand's eco-labels represent genuine environmental concern.①②③④⑤⑥⑦

GT3. This company's environmental claims are reliable.①②③④⑤⑥⑦

GT4. I have confidence in this company's environmental promises.①②③④⑤⑥⑦

GT5. This company's environmental performance meets my expectations.①②③④⑤⑥⑦

Part IV: Purchase Intentions

Purchase Intention (PI)

Adapted from Ajzen (2006)

PI1. I intend to purchase eco-labeled products in the next six months.①②③④⑤⑥⑦

PI2. I will make an effort to buy eco-labeled alternatives when available.①②③④⑤⑥⑦

PI3. I plan to purchase more eco-labeled products in the future.①②③④⑤⑥⑦

Part V: Cultural Values

Cultural Dimensions

Hofstede's Values Survey Module 2013 (VSM-13) - Selected Items

Instructions: Please think of an ideal job, disregarding your present job, if you have one. In choosing an ideal job, how important would it be to you to have:

Scale: 1 = Of utmost importance, 2 = Very important, 3 = Of moderate importance, 4 = Of little importance, 5 = Of very little or no importance

CV1. Have sufficient time for your personal or home life.①②③④⑤

CV2. Have good physical working conditions.①②③④⑤

CV3. Have security of employment.①②③④⑤

CV4. Do work that is interesting.①②③④⑤

CV5. Have the opportunity for high earnings.①②③④⑤

CV6. Work with people who cooperate well with one another.①②③④⑤

Instructions: In your private life, how important is each of the following to you?

CV7. Keeping time free for fun.①②③④⑤

CV8. Moderation: having few desires.①②③④⑤

CV9. Being generous to other people.①②③④⑤

Instructions: Please indicate your level of agreement with the statements below:

CV10. One can be a good manager without having precise answers to most questions that subordinates may raise about their work.①②③④⑤⑥⑦

CV11. Persistency (perseverance) is a virtue.①②③④⑤⑥⑦

CV12. Thrift (saving money and resources) is a virtue.①②③④⑤⑥⑦

Part VI: Demographics

D1. What is your gender?

- [ ] Male
- [ ] Female
- [ ] Non-binary
- [ ] Prefer not to answer

D2. What is your highest level of education completed?

- [ ] Less than high school
- [ ] High school diploma/equivalent
- [ ] Some college/university
- [ ] Bachelor's degree
- [ ] Master's degree
- [ ] Doctoral degree
- [ ] Professional degree

D3. What is your approximate annual household income? (Select the appropriate range for your country)

United States (USD):

- [ ] Under $25,000
- [ ] $25,000 - $49,999
- [ ] $50,000 - $74,999
- [ ] $75,000 - $99,999
- [ ] $100,000 - $149,999
- [ ] $150,000 or more

Germany (EUR):

- [ ] Under €20,000
- [ ] €20,000 - €39,999
- [ ] €40,000 - €59,999
- [ ] €60,000 - €79,999
- [ ] €80,000 - €119,999
- [ ] €120,000 or more

[Similar ranges provided for Japan (JPY), South Korea (KRW), Brazil (BRL), Netherlands (EUR)]

D4. What is your employment status?

- [ ] Employed full-time
- [ ] Employed part-time

- [ ] Self-employed
- [ ] Student
- [ ] Retired
- [ ] Unemployed
- [ ] Other: _____

D5. In which type of area do you live?

- [ ] Urban (city)
- [ ] Suburban
- [ ] Rural

Attention Checks and Quality Controls

AC1. Please select "Somewhat Agree" (option 5) for this question.①②③④⑤⑥⑦

AC2. In your opinion, what color is the sky on a clear day?

- [ ] Red
- [ ] Green
- [ ] Blue
- [ ] Purple

IMC1. This question is designed to test if you are paying attention. If you are reading this carefully, please select "Disagree" (option 2).①②③④⑤⑥⑦

Survey Closing

Thank you for participating in this research study. Your responses are valuable for understanding how consumers perceive eco-labels across different cultural contexts. If you have any questions about this research, please contact [researcher contact information].

Notes:

- (R) indicates reverse-coded items
- All construct items were measured on 7-point Likert scales unless otherwise specified
- Items were presented in randomized order within each construct to minimize order effects
- Survey was translated and back-translated for non-English speaking countries
- Country-specific product examples and eco-labels were used where appropriate