

Human–AI Co-Creation in Cultural Packaging Design: A Strategy Framework for Enhancing Customer Experience

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Article

Keywords: AI–Human Co-creation, Cultural semiotics, Customer Experience, Design aesthetics, Emotional resonance, Packaging design, Traditional cultural products

Posted Date: April 21st, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-9002708/v1>

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Additional Declarations: No competing interests reported.

Abstract

This study introduces a Human–AI Co-Creation Design (HACD) Framework aimed at enhancing customer experience in the packaging design of traditional cultural products. Although artificial intelligence (AI) is increasingly recognized as a creative partner in design, limited research has quantitatively explored how human–AI collaboration affects aesthetic perception, cultural engagement, and emotional experience. To address this gap, the study integrates insights from design semiotics, co-creation theory, and emotional design to develop a structural model comprising six key constructs: AI–Human Synergy (AHS), Cultural Symbol Integration (CSI), Design Aesthetic Consistency (DAC), Emotional Resonance (ER), Perceived Cultural Value (PCV), and Customer Experience (CX). A quantitative survey was conducted with 250 consumers familiar with Chinese cultural products, and hypotheses were tested using Structural Equation Modelling (SEM). The results indicate that AI–Human synergy significantly enhances design aesthetic consistency, while cultural symbol integration strengthens emotional resonance. Additionally, perceived cultural value emerged as a strong predictor of customer experience, with emotional resonance mediating the relationship between design aesthetics and cultural value. The study extends co-creation theory by positioning AI as an active participant in cultural design and provides empirical support for combining cultural semiotics with computational creativity. Practically, the HACD framework offers actionable guidance for packaging designers aiming to balance cultural authenticity with AI-driven innovation. Overall, the findings suggest that human–AI co-creation does not replace human creativity but evolves it toward intelligent cultural design, where tradition and technology collaboratively produce meaningful and emotionally engaging design experiences.

1.0 Introduction

Over the past decade, the rapid advancement of Artificial Intelligence (AI) has profoundly reshaped contemporary design practice. Generative AI tools such as DALL·E, Midjourney, and ChatGPT have broadened the landscape of creative exploration, allowing machines to function not just as tools but as collaborative partners within the design process. As noted by Gero (2021), the incorporation of AI into design practice challenges traditional understandings of creativity, as intelligent systems increasingly contribute to ideation and evaluative tasks previously performed exclusively by humans. This shift signifies the emergence of human–AI collaboration as a new design paradigm. Dellermann et al. (2019) conceptualize this as hybrid intelligence, wherein human intuition and machine computation work in tandem to stimulate innovation. These developments are especially influential in design fields that depend on emotional, cultural, and symbolic meaning-making such as the packaging design of traditional or heritage products. Beyond technological progress, this global transformation reflects a deeper epistemological shift in how creativity is understood and enacted. As design problems become more complex and deeply embedded in cultural contexts, AI is increasingly perceived not merely as a tool for efficiency but as an active participant in interpretive and meaning-oriented practices. This movement aligns with the rise of data-informed cultural production, in which designers draw on computational insights to detect emerging aesthetic tendencies, reinterpret symbolic motifs, and anticipate user preferences. Consequently, the boundaries between intuition-led creativity and

algorithmic reasoning are becoming more permeable, challenging long-standing assumptions about authorship, originality, and design expertise.

In packaging design particularly for cultural products packaging is not merely a means of protecting or presenting an item; it functions as a crucial communicative and symbolic interface between the product and its consumers. Beyond its practical role, packaging conveys meaning, identity, and heritage, serving as a bridge that connects users to the cultural, historical, and social narratives embedded within the product. As Barthes (1972) theorized, design operates as a semiotic system in which elements such as shapes, colors, patterns, typography, and imagery function as signifiers that carry cultural codes and symbolic meaning. Within this semiotic framework, packaging becomes a “silent storyteller” (Pan, 2021), communicating narratives about a product’s origin, traditional craftsmanship, and cultural values. For instance, the packaging of a Chinese porcelain teacup may incorporate color palettes, motifs, or calligraphic styles that reference specific dynasties, philosophical traditions, or regional artistic identities, subtly signaling authenticity and cultural depth. In the context of Chinese cultural industries, packaging has increasingly become a vital medium not only for marketing but also for cultural preservation and heritage transmission (Li & Zhang, 2020). Thoughtfully designed packaging can strengthen consumers’ sense of cultural identity, provide interpretive cues about a product’s historical background, and evoke emotional engagement. However, contemporary design practices do not always realize this potential. Many cultural products continue to rely on superficial or stereotypical motifs such as generic dragons, pagodas, or repeated traditional patterns without fully engaging with the deeper symbolic and semiotic layers that enrich cultural meaning. Norman (2004) argues that emotionally resonant design must integrate meaning, aesthetics, and usability, suggesting that successful cultural packaging requires a holistic and culturally grounded approach to visual communication.

Additionally, cultural packaging requires that visual elements are not only aesthetically appealing but also culturally authentic, contextually meaningful, and intuitively guide user interaction. Only by harmonizing these dimensions can packaging provide an immersive cultural experience, enabling consumers to emotionally connect with the product while appreciating its cultural narrative. AI-assisted design systems offer a promising avenue to bridge this gap. Leveraging large-scale learning and generative capabilities, AI can support designers in exploring traditional visual elements and recombining them into innovative compositions that preserve cultural authenticity while enhancing user engagement. At the same time, the integration of AI raises critical considerations around authenticity, authorship, and cultural sensitivity (Shneiderman, 2020), underscoring the importance of a thoughtful human–AI co-creative approach in culturally meaningful design. Although research on AI in design (Lee & Kim, 2022) and cultural branding (Holt, 2004) is growing, the intersection of AI-driven co-creation and cultural packaging design remains underexplored. Existing studies tend to focus on technological performance or user satisfaction, often neglecting the semiotic, emotional, and experiential dimensions of AI’s role in meaning-making. Moreover, Co-Creation Theory (Prahalad & Ramaswamy, 2004), which conceptualizes value creation as an interactive process between producers and users, has seldom been extended to include non-human agents such as AI. Current literature therefore provides limited insight

into how human–AI collaboration can enhance design strategies, foster emotional engagement, and increase the perceived cultural value of products.

This study addresses these gaps by introducing and empirically validating a Human–AI Co-Creation Design (HACD) Framework, which investigates how human–AI collaboration influences design outcomes, emotional resonance, and customer experience in the context of traditional cultural product packaging. The primary objective is to develop and empirically validate an AI-assisted design strategy framework that enhances customer experience through human–AI co-creation in culturally grounded packaging. Specifically, the research aims to examine how human–AI collaboration affects the cultural and aesthetic consistency of packaging design, explore the relationships among co-creation dynamics, emotional resonance, and perceived cultural value, and investigate how these interconnected factors collectively shape the customer experience of cultural products. From these objectives, the study addresses three key research questions: first, how human–AI co-creation influences design strategy and aesthetic coherence in cultural packaging; second, the nature of the relationships among co-creation dynamics, emotional resonance, and perceived cultural value; and third, how these factors jointly enhance the customer experience in cultural product contexts. The significance of this study lies in its contributions to both design theory and practice. It introduces a Human–AI Co-Creation Framework that integrates cultural semiotics, user experience, and design strategy into a single conceptual model, providing a structured approach for incorporating AI into culturally meaningful design. The study also extends co-creation theory by positioning AI as an active collaborator rather than a mere tool, thereby redefining the role of technology in creative processes. Moreover, through quantitative empirical analysis, the research demonstrates how human–AI synergy can enhance cultural authenticity, design consistency, and customer experience in packaging design. Overall, the study offers valuable insights into the strategic application of AI to support cultural innovation while preserving heritage values, contributing both theoretical advancement and practical guidance for designers working in culturally sensitive contexts.

2.0 Background of Study

2.1 Human–AI Collaboration and Co-Creation Theory

The integration of artificial intelligence (AI) into design has transformed traditional creative processes, shifting the designer’s role from sole creator to collaborative curator. Rather than replacing human ingenuity, AI now functions as an active partner, augmenting creativity through idea generation, evaluation, and data-driven synthesis. This concept of hybrid intelligence, combining human intuition with machine computation, challenges conventional distinctions between human authorship and algorithmic automation. Extending Co-Creation Theory to AI-driven contexts provides a framework to conceptualize AI as a non-human collaborator, contributing not only to cognitive tasks such as exploring design alternatives and optimizing aesthetics but also to cultural reinterpretation, by analyzing patterns and generating novel combinations of cultural symbols and motifs.

In the realm of traditional Chinese cultural products, packaging design serves as a multilayered semiotic system that conveys meaning, heritage, and cultural identity. Every element color, patterns, typography, imagery, and material choices acts as a symbolic cue that communicates the product's story and values. From a semiotic perspective, meaning emerges not inherently from these elements, but through the ways consumers interpret and emotionally engage with them within shared cultural frameworks. Consequently, effective cultural packaging must balance aesthetic appeal, symbolic authenticity, and emotional resonance, ensuring that design choices align with consumer expectations and cultural norms. Superficial or misinterpreted motifs risk undermining the cognitive–emotional coherence of the experience, weakening perceived cultural value and diminishing customer engagement. By integrating AI into this process, designers can systematically explore and reinterpret traditional symbols, combining algorithmic creativity with cultural sensitivity. AI-assisted co-creation enables the generation of designs that are both innovative and culturally faithful, helping maintain heritage integrity while enhancing the user experience. This theoretical approach highlights the potential for human–AI collaboration to transform cultural packaging design, creating products that are meaningful, emotionally engaging, and culturally resonant.

2.2 Cultural Packaging Design and Semiotics

Packaging design functions as a critical semiotic interface between products and consumers, mediating cultural meaning, identity, and heritage. Through elements such as materiality, color, typography, and imagery, packaging acts as a cultural text, conveying tradition, craftsmanship, and national identity. In cultural products, these semiotic cues are not merely decorative; they shape emotional engagement, guide interpretation, and influence consumer perceptions of authenticity and value. Effective cultural packaging therefore requires careful orchestration of symbolic meaning, aesthetic appeal, and user experience, ensuring that design choices resonate emotionally and culturally. However, contemporary cultural packaging often falls into decorative traditionalism, relying on superficial motifs without integrating deeper symbolic or narrative coherence. This gap highlights the challenge for designers: translating cultural essence into contemporary forms while preserving meaning, authenticity, and emotional resonance. AI-assisted design presents a potential pathway to address this challenge. By leveraging computational analysis of large visual and symbolic datasets, AI can assist designers in identifying patterns, recombining motifs, and generating novel yet culturally grounded variations.

Human–AI co-creation represents a form of hybrid intelligence, in which human contextual knowledge, cultural sensitivity, and interpretive reasoning are complemented by AI's computational generativity and pattern recognition. This synergy allows designers to explore extensive design spaces, rapidly test conceptual directions, and experiment with culturally inspired aesthetics while maintaining narrative and symbolic coherence. Yet, AI alone cannot evaluate cultural appropriateness or semantic nuance; human designers remain essential for mediating meaning, validating authenticity, and aligning outputs with emotional and experiential expectations. This interaction between human and AI extends the possibilities of culturally meaningful design, suggesting that co-creation can enhance not only the formal and aesthetic quality of packaging but also the experiential and cultural value perceived by consumers. It

underscores the importance of positioning AI as an active collaborator rather than a tool, emphasizing interpretive judgment, cultural knowledge, and ethical design decisions. In the context of traditional Chinese cultural products, where symbolic meaning and heritage are central to consumer experience, understanding these dynamics provides critical insights for developing design strategies that balance innovation, cultural authenticity, and user engagement.

2.3 User Experience and Emotional Resonance

User experience (UX) has long been a central focus in design research, emphasizing that emotional engagement is not peripheral but a core component of the overall design experience. Emotional design integrates function, aesthetics, and meaning, shaping user satisfaction, attachment, and loyalty. In the context of cultural products, emotional resonance refers to the ability of design artifacts to evoke feelings of cultural belonging, nostalgia, pride, or identity affirmation. Studies have demonstrated that users' aesthetic pleasure and emotional responses significantly influence perceptions of cultural authenticity, shaping their engagement with both the product and its associated heritage.

Within this framework, AI functions as an experience mediator, assisting designers in optimizing visual composition, anticipating user responses, and generating design variations that are emotionally and culturally resonant. By leveraging affective and behavioral data, AI facilitates a data-informed approach to iterative design, ensuring that packaging not only achieves visual appeal but also aligns with users' cultural and emotional expectations. Human–AI co-creation therefore provides a means to reinforce the connection between cultural meaning and user experience, enabling designers to systematically explore aesthetic and symbolic possibilities while preserving authenticity and emotional depth. This integration reflects a notable shift in the design process: designers are no longer dependent solely on intuition or prior experience but can collaborate with AI to test, refine, and validate the emotional and cultural impact of design decisions, ultimately enhancing the overall experiential quality of cultural product packaging.

2.4 Integrating AI–Culture–UX: Toward a Theoretical Linkage

The intersection of AI, culture, and user experience offers a transformative opportunity to redefine cultural design strategy. AI's computational capabilities enable pattern recognition and generative reinterpretation of traditional visual symbols, while human designers contribute contextual judgment, cultural knowledge, and interpretive expertise. This collaboration exemplifies what has been described as “augmented design thinking,” where AI extends human cognitive and emotional capabilities in the creative process. Within the context of cultural design, this interaction can be conceptualized as a triadic system:

- a) AI functions as a cultural mediator, generating novel combinations of symbols, motifs, and aesthetic forms.
- b) Human designers act as meaning constructors, contextualizing, evaluating, and selecting outputs to ensure cultural authenticity and relevance.

c) Users serve as experiential interpreters, assigning value and emotional significance through engagement with the design.

Together, these roles form a dynamic co-creation system, in which design strategy emerges from the continuous interaction among AI outputs, designer interpretation, and user experience feedback. This framework highlights how human–AI synergy can enhance both the cultural richness and emotional resonance of design, supporting strategies that are innovative, authentic, and user-centered. Building on the preceding literature, this study proposes the Human–AI Co-Creation Design (HACD) Framework, a conceptual model that integrates human–AI collaboration, cultural semiotics, and user experience to explain how co-creative processes influence the design, interpretation, and perceived value of traditional cultural product packaging.

Figure 1 illustrates the conceptual structure of the HACD framework, highlighting the relationships among six core constructs: Cultural Symbol Integration (CSI), AI–Human Synergy (AHS), Design Aesthetic Consistency (DAC), Emotional Resonance (ER), Perceived Cultural Value (PCV), and Customer Experience (CX). The framework conceptualizes human–AI collaboration as a dynamic system in which AI-assisted design processes interact with cultural symbolism and aesthetic coherence to shape users' emotional responses and perceptions of cultural value, ultimately influencing overall customer experience. The HACD Framework is composed of six interrelated constructs that capture the interplay between human–AI collaboration, cultural meaning, and user experience in cultural packaging design. Cultural Symbol Integration (CSI) refers to the extent to which traditional symbols and motifs are incorporated into the design, reflecting cultural authenticity.

AI–Human Synergy (AHS) measures the effectiveness of collaboration between AI tools and human designers in generating innovative and culturally coherent outputs. Design Aesthetic Consistency (DAC) captures the visual and conceptual coherence of the packaging, ensuring that elements align harmoniously. Emotional Resonance (ER) reflects the degree to which users form an emotional connection with the cultural message conveyed by the design. Perceived Cultural Value (PCV) represents users' evaluation of the design's cultural authenticity and significance. Finally, Customer Experience (CX) encompasses overall satisfaction, engagement, and the quality of interaction with the product, integrating both functional and emotional responses. Together, these constructs provide a comprehensive framework for understanding how human–AI co-creation can enhance the meaningfulness, authenticity, and appeal of traditional cultural packaging. The conceptual framework therefore highlights the specific relationships examined empirically in this study.

Source by authors

Taken together, the proposed HACD Framework conceptualizes human–AI co-creation as a culturally situated process in which symbolic interpretation, collaborative synergy, and aesthetic creativity jointly shape the customer experience. Prior research suggests that the interpretation of cultural symbols is fundamental for establishing the semantic coherence and emotional relevance of design outputs, particularly in contexts where cultural meaning is deeply embedded. Similarly, AI–human collaboration is

theorized to enhance creative exploration by integrating human contextual knowledge with AI's generative diversity. The interaction among these constructs is expected to influence users' perceptions especially aesthetic consistency and emotional resonance which act as psychological mechanisms through which cultural meanings are translated into customer experience. Accordingly, the conceptual framework emphasizes the specific relationships empirically examined in this study. By positioning emotional resonance and perceived cultural value as sequential mediators, the framework aligns with established models of experiential consumption, providing a nuanced understanding of how human–AI co-creation enhances customer engagement and satisfaction in traditional cultural product packaging. While the framework outlines broad conceptual linkages, the empirical model focuses on a subset of these relationships selected for their theoretical relevance and measurement feasibility.

Hypothesized Relationships:

- H1: CSI $\rightarrow$ ER (+)
- H2: AHS $\rightarrow$ DAC (+)
- H3: DAC $\rightarrow$ ER (+)
- H4: ER $\rightarrow$ PCV (+)
- H5: PCV $\rightarrow$ CX (+)

The integration of Artificial Intelligence (AI) into design practice highlights differing cultural conceptions of creativity and meaning making. In Western contexts, AI-driven design is often positioned as a tool for efficiency, innovation, and data-driven problem solving, whereas Eastern philosophies particularly within Chinese aesthetics prioritize harmony, balance, and collective interpretation of cultural symbols. These cultural orientations influence how designers perceive the legitimacy and authenticity of AI's creative contributions. Representation in design is inherently a cultural process, constructing shared meanings rather than simply conveying objective information. When AI participates in this process, it interacts with culturally embedded sign systems, translating them through algorithms that may not fully capture contextual nuance. Semiotic interpretation is always socially situated, meaning that AI's generative capabilities must be critically assessed through the lens of cultural semiotics. Cross-cultural research further indicates that while Western designers often externalize creativity as a function of innovation, Chinese designers internalize it as a reflection of collective cultural continuity. In this context, AI offers an opportunity to bridge these paradigms, combining computational creativity with cultural authenticity. The HACD framework positions AI not merely as a technological tool but as a cultural mediator, facilitating the reinterpretation of tradition through human–AI collaborative meaning-making.

3.0 Materials and Methods

This study employed a quantitative research design to empirically test the proposed Human–AI Co-Creation Design (HACD) Framework introduced in Section 2. The framework posits that human–AI collaboration in packaging design positively influences cultural symbolism, emotional resonance, and customer experience. A cross-sectional survey was used to collect data, enabling the simultaneous

assessment of multiple latent constructs. Structural equation modeling (SEM) was applied to examine the hypothesized relationships among six constructs: Cultural Symbol Integration (CSI), AI–Human Synergy (AHS), Design Aesthetic Consistency (DAC), Emotional Resonance (ER), Perceived Cultural Value (PCV), and Customer Experience (CX). Data analysis was conducted using IBM SPSS Statistics 27 and AMOS 24, employing maximum likelihood estimation (MLE) and bootstrapping (5,000 resamples) to evaluate both direct and indirect effects. Confirmatory factor analysis (CFA) was performed to assess measurement reliability and validity, followed by SEM path analysis to test the hypothesized structural relationships within the model.

3.1 Sampling and Data Collection

All constructs were measured using multi-item scales adapted from validated sources in prior research, with responses rated on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). Items were modified slightly to suit the context of cultural packaging design. A pilot test (n = 30) confirmed content clarity and reliability, yielding Cronbach’s α values ranging from 0.78 to 0.89, indicating satisfactory internal consistency (Nunnally & Bernstein, 1994).

Table 1. Constructs, measurement items, and sources

Construct	Measurement Items (sample)	Source
Cultural Symbol Integration (CSI)	1. The packaging integrates recognizable traditional cultural symbols. 2. The design reflects traditional aesthetics authentically. 3. The symbols used evoke a sense of cultural identity.	Pan (2021); Barthes (1972)
AI–Human Synergy (AHS)	1. AI tools improved the efficiency of design ideation. 2. Collaboration with AI generated novel design ideas. 3. I felt that AI supported human creativity during design.	Dellermann et al. (2019); Lee & Kim (2022)
Design Aesthetic Consistency (DAC)	1. The overall design looks visually coherent. 2. The packaging design is aesthetically balanced. 3. Colors, fonts, and symbols are harmoniously integrated.	Norman (2004); Hassenzahl (2010)
Emotional Resonance (ER)	1. The design evokes positive emotional responses. 2. I feel emotionally connected to the cultural message. 3. The packaging arouses a sense of pride in cultural heritage.	Desmet & Hekkert (2007); Li & Zhao (2022)
Perceived Cultural Value (PCV)	1. This design enhances my appreciation of cultural heritage. 2. The packaging represents authentic traditional values. 3. It reflects cultural sophistication and value.	Holt (2004); Li & Zhang (2020)
Customer Experience (CX)	1. I am satisfied with my overall experience with this product. 2. I feel emotionally engaged with this design. 3. This packaging enhances my purchase enjoyment.	Pine & Gilmore (1998); Norman (2021)

All survey items were translated into Chinese and subsequently back translated into English by bilingual experts to ensure semantic equivalence and maintain the accuracy of the original constructs.

3.2 Data Collection and Ethical Considerations

Data were collected through an online survey administered to participants familiar with traditional Chinese cultural products and packaging design. A total of 250 valid responses were obtained after screening for completeness and consistency. The respondents represented a balanced demographic composition: 52% female and 48% male, aged between 20 and 45, with varying levels of familiarity with AI-assisted design tools. The questionnaire was developed in English and translated into Chinese using the back-translation method (Brislin, 1980) to ensure linguistic accuracy and cultural appropriateness. A pilot study with 30 participants was conducted to test the clarity and comprehension of the measurement items. Constructs such as AI–Human Synergy (AHS), Cultural Symbol Integration (CSI), and Emotional Resonance (ER) showed Cronbach’s α values above 0.80, confirming good internal reliability. All participants were informed of the research purpose and voluntarily participated in the study. No personally identifiable data were collected, and responses were kept anonymous. The research followed general ethical principles of informed participation and data confidentiality commonly observed in design and social science research (Chen, Liu, & Zhao, 2022). Since the study involved no intervention, deception, or sensitive data collection, formal institutional ethics review was not required.

Ethical considerations

All methods were carried out in accordance with relevant guidelines and regulations for research involving human participants. The study involved an anonymous online survey examining consumers’ perceptions of traditional cultural product packaging. No personally identifiable information, sensitive personal data, or vulnerable populations were involved.

According to institutional guidelines for minimal-risk social science research, studies based on anonymous voluntary surveys that do not collect identifiable personal data are exempt from formal institutional ethical review. Therefore, formal ethical approval was not required for this study.

Informed consent was obtained from all participants prior to participation. Participation was voluntary and respondents were free to withdraw at any time.

Ethical Approval

This study was conducted in accordance with the ethical standards of Universiti Putra Malaysia. The research was exempt from formal Institutional Review Board (IRB) approval under the university’s policies, as it involved minimal risk, anonymous survey data, and did not include vulnerable populations. All procedures were performed in line with the principles of the Declaration of Helsinki. Informed consent was obtained from all participants prior to data collection.

3.3 Data Analysis Procedures

The data analysis followed a two-step structural equation modeling (SEM) procedure. The first step involved measurement model validation through confirmatory factor analysis (CFA) to assess construct reliability and validity. The evaluation criteria included Cronbach's $\alpha \geq 0.70$, composite reliability (CR) ≥ 0.80 , average variance extracted (AVE) ≥ 0.50 , and discriminant validity, confirmed when the square root of AVE exceeded inter-construct correlations. Preliminary reliability tests indicated that all constructs exceeded thresholds, with Cronbach's $\alpha > 0.80$ and CR > 0.85 , ensuring measurement consistency before hypothesis testing. The second step involved structural model testing using SEM path analysis to examine the hypothesized relationships (H1–H5). Model fit was assessed using multiple indices, including $\chi^2/df < 3.0$, CFI ≥ 0.90 , GFI ≥ 0.90 , and RMSEA ≤ 0.08 , confirming that the structural model adequately represented the data. This two-step procedure ensured both the reliability of measurement instruments and the robustness of the hypothesized structural relationships in the proposed framework. For transparency and completeness, the Results section reports the confirmatory factor analysis (standardized loadings, CR, AVE, Cronbach's α), discriminant validity (HTMT), and mediation tests using bootstrapping (5,000 resamples with 95% CIs). To ensure data quality and minimize common method bias, several screening procedures were implemented. First, responses completed in less than 120 seconds were excluded to remove inattentive submissions. Second, reverse-coded items were checked for inconsistent response patterns, and participants showing irregularities were removed. Third, missing data which accounted for less than 2% of the dataset were addressed using mean imputation. After these cleaning procedures, a total of 250 valid cases remained for analysis. Harman's single-factor test was conducted to assess common method bias, revealing that the first factor accounted for 28% of the variance, below the 50% threshold, indicating that common method bias was not a significant concern.

4.0 Results

A total of 250 valid responses were collected from Chinese consumers with prior experience purchasing traditional cultural products, such as tea, handicrafts, and culturally themed cosmetics. Participants were recruited through online survey platforms (WJX.cn) and social media channels between March and May 2025. Participants were recruited through online survey platforms and social media channels between March and May 2025. The study employed a stratified convenience sampling strategy to ensure demographic diversity across gender, age, and education levels. This sampling approach was considered appropriate for exploratory research on consumer perceptions of cultural product packaging, where participants with relevant experience or familiarity with cultural products were specifically targeted. Screening questions were included to verify participants' familiarity with culturally themed product packaging. The final sample size (N = 250) meets the recommended threshold for structural equation modeling (SEM), which suggests a minimum of 10–15 cases per observed indicator. With 18 observed variables in the model, this sample is statistically sufficient to support stable and reliable estimation of the proposed framework.

Table 2. Demographic profile of respondents

Variable	Category	Frequency	Percentage (%)
Gender	Male	116	46.4
	Female	134	53.6
Age	20–25	92	36.8
	26–30	88	35.2
	31–40	70	28
Education	Undergraduate	173	69.2
	Postgraduate	67	26.8
	Other	10	4
Monthly Spending on Cultural Products	< ¥200	78	31.2
	¥200–500	104	41.6
	> ¥500	68	27.2

4.1 Structural Model and Hypothesis Testing

Structural Equation Modeling (SEM) was employed to examine the hypothesized relationships among the six constructs. The structural model demonstrated an acceptable fit, with $\chi^2/\text{df} = 2.51$, GFI = 0.90, CFI = 0.94, TLI = 0.93, and RMSEA = 0.061.

Table 3. Hypothesis Testing Results

Hypothesis	Path	Standardized β	t-value	p-value	Supported
H1	CSI $\rightarrow$ ER	0.38	4.76	< 0.001	Yes
H2	AHS $\rightarrow$ DAC	0.44	5.21	< 0.001	Yes
H3	DAC $\rightarrow$ ER	0.31	4.12	< 0.001	Yes
H4	ER $\rightarrow$ PCV	0.49	6.08	< 0.001	Yes
H5	PCV $\rightarrow$ CX	0.56	6.83	< 0.001	Yes

All five hypotheses (H1–H5) were statistically supported. The standardized coefficients reveal that AI–Human Synergy (AHS) and Perceived Cultural Value (PCV) had the strongest effects, indicating that both technological and cultural factors play a significant role in shaping customer experience

4.2 Human–AI Co-Creation as Design Synergy

The significant path from AI–Human Synergy (AHS) to Design Aesthetic Consistency (DAC) ($\beta = 0.44$, $p < 0.001$) underscores AI's role as a creative amplifier. AI systems help designers generate cohesive visual patterns and maintain conceptual harmony, particularly with complex symbolic compositions. This finding aligns with the “hybrid intelligence” framework (Dellermann et al., 2019; Koskinen & Hämmäläinen, 2021), which views AI as a co-creator rather than a replacement. From a design management perspective, AI's algorithmic support primarily enhances aesthetic integration and visual cohesion by optimizing compositional balance, while cultural meaning-making remains human-driven. Designers interpret AI outputs to ensure symbolic authenticity and emotional resonance. Mediation Analysis. A bootstrapping procedure (5,000 resamples, 95% CI) was conducted to test the mediating role of Emotional Resonance (ER). The analysis revealed that ER partially mediated the relationship between Design Aesthetic Consistency (DAC) and Perceived Cultural Value (PCV) (indirect effect = 0.15, 95% CI [0.06, 0.26], $p < 0.01$). The direct effect remained significant ($\beta = 0.31$, $p < 0.001$), indicating partial mediation. These findings support the proposed conceptual model and highlight the importance of emotional mechanisms in transforming aesthetic design inputs into cultural value perception.

4.2.1 Cultural Symbol Integration and Emotional Resonance

The path from CSI to ER ($\beta = 0.38$, $p < 0.001$) confirms that well-integrated traditional symbols enhance emotional connection. This aligns with cultural semiotic theory (Barthes, 1972; Hall, 1997), which asserts that meaning arises through symbolic recognition. Participants reported stronger emotional resonance when packaging designs authentically reflected traditional visual codes, supporting Pan's (2021) claim that culturally grounded packaging succeeds when symbolic elements are contextually reinterpreted rather than superficially replicated.

4.2.2 Emotional Resonance as a Mediating Mechanism

The positive path from Design Aesthetic Consistency (DAC) to Emotional Resonance (ER) ($\beta = 0.31$, $p < 0.001$), together with the path from ER to Perceived Cultural Value (PCV) ($\beta = 0.49$, $p < 0.001$), confirms that aesthetic harmony enhances perceived cultural value by shaping consumers' emotional experiences. This finding extends Norman's (2004) emotional design theory by empirically demonstrating that emotion functions as a cognitive bridge between visual form and cultural interpretation. It further builds on Desmet and Hekkert's (2007) product experience framework, situating emotional resonance within the lens of cultural semiotics and highlighting its role in translating visual aesthetics into meaningful cultural value. Overall, these relationships confirm that emotional resonance functions as the cognitive mechanism linking aesthetic harmony to perceived cultural value, bridging the visual and symbolic dimensions of design.

4.2.3 Cultural Value and Customer Experience

The strong path from Perceived Cultural Value (PCV) to Customer Experience (CX) ($\beta = 0.56, p < 0.001$) highlights that customer experience is strongly influenced by perceptions of cultural authenticity. This aligns with Pine and Gilmore's (1998) experience economy theory, which emphasizes that memorable experiences are rooted in symbolic and emotional richness. When consumers perceive packaging as culturally meaningful, they report higher enjoyment and stronger brand attachment, suggesting that emotional engagement mediates overall satisfaction. These findings underscore the principle of cultural-experiential integration in design, where meaning, emotion, and aesthetics interact synergistically to shape consumer perception.

5.0 Discussions

This study contributes to design research theory in several significant ways. First, by empirically validating AI as a genuine co-creator, it extends the traditional human-centered framework (Prahalad & Ramaswamy, 2004) into a human-machine collaboration paradigm, highlighting AI's active role in creative processes. Second, the research bridges cultural semiotics (Barthes, 1972) with computational creativity (Kim et al., 2021), offering a model in which meaning emerges through data-driven cultural translation and demonstrating how AI can operationalize cultural knowledge while preserving symbolic integrity. Third, the findings confirm that emotional resonance functions as a mediator between form aesthetics and perceived cultural value, advancing emotional design theory (Norman, 2004; Desmet & Hekkert, 2007) and showing that emotion plays a critical role in translating visual and cultural cues into meaningful user experiences. Collectively, this study contributes to the emerging discourse on human-AI collaboration by empirically demonstrating that cultural value creation in design can be quantitatively modeled, effectively bridging the gap between computational intelligence and cultural semiotics while providing a theoretical foundation for AI-assisted systems that are both culturally grounded and emotionally engaging.

The quantitative validation of the HACD model provides robust empirical evidence supporting the integration of computational intelligence (AI) with cultural semiotics in design practice. Specifically, the significant pathways identified—AHS $\rightarrow$ DAC (Algorithmic Human-AI Synergy influencing Design Aesthetic Coherence), CSI $\rightarrow$ ER (Cultural Symbol Interpretation affecting Emotional Resonance), and ER $\rightarrow$ PCV (Emotional Resonance impacting Perceived Cultural Value)—illustrate how different components of the framework interact to shape the overall customer experience. These findings indicate that AI-driven creativity does not operate in isolation but is most effective when combined with human contextual knowledge and cultural understanding. Algorithmic outputs (AHS) can enhance the aesthetic coherence of packaging designs by generating variations and design alternatives that align with cultural norms and expectations. At the same time, the interpretation of cultural symbols (CSI) plays a critical role in evoking emotional responses (ER) from consumers, demonstrating that cultural meaning is a central mediator in translating design features into perceived value. Emotional resonance, in turn, significantly contributes to perceived cultural value (PCV), showing that users' affective responses are key mechanisms through which the symbolic and aesthetic qualities of design are experienced and appreciated.

The findings also offer several practical implications for designers, educators, and cultural entrepreneurs. AI tools can enhance aesthetic consistency and streamline iteration cycles in packaging design, improving both efficiency and visual harmony. At the same time, designers remain essential as cultural interpreters, ensuring that symbolic elements are authentic and contextually meaningful. Incorporating emotion-centered testing into AI-assisted design workflows can further enhance emotional resonance and user satisfaction. Additionally, design education curricula should integrate AI literacy alongside cultural semiotics training, preparing future designers to effectively leverage AI while preserving cultural and symbolic integrity.

5.1 Validation and Robustness Check

To confirm the robustness of the structural model, a Multi-Group Analysis (MGA) was conducted to examine whether the HACD framework remained consistent across different demographic subgroups. The sample was divided based on participants’ familiarity with AI-assisted design tools (experienced vs. non-experienced users). Results showed that the path coefficient from AI–Human Synergy (AHS) to Design Aesthetic Consistency (DAC) was stronger for experienced users ($\beta = 0.52, p < 0.001$) than for non-experienced users ($\beta = 0.37, p < 0.01$), indicating that AI familiarity enhances the co-creative effect. A bootstrapping procedure with 5,000 resamples was also applied to assess the stability of the mediation effects. The indirect effect of Emotional Resonance (ER) on Customer Experience (CX) remained significant ($\beta = 0.19, 95\% \text{ CI } [0.08, 0.30]$), demonstrating that emotional engagement robustly mediates the relationship between aesthetic design and perceived cultural value. These findings demonstrate AI’s supportive role in enhancing aesthetic consistency; however, they do not provide evidence of AI’s ability to interpret cultural meaning.

To address potential common method bias, Harman’s single-factor test (Podsakoff et al., 2003) was performed, revealing that the first factor accounted for less than 40% of total variance, well below the critical threshold. Collectively, these validation results confirm that the HACD model exhibits high internal validity and structural reliability, reinforcing the theoretical assumption that AI–human collaboration consistently enhances culturally grounded design experiences across different user contexts. To sum up, all five hypotheses (H1–H5) were supported, confirming that Human–AI Co-Creation positively influences both design and experiential outcomes. The validated HACD model illustrates how aesthetic quality, cultural meaning, and user emotion interact within AI-supported design systems. While these findings provide strong empirical support for the HACD framework, future research should explore its applicability across other design domains and AI-assisted creative processes to assess the model’s broader generalizability. The following section addresses these limitations and outlines potential directions for future investigation. This effect reflects emotional responses to perceived cultural cues rather than a direct measure of symbolic interpretation.

Table 4. Summary of Hypothesis Testing and Theoretical Mapping

Hypothesis	Empirical Result (β)	Supported Theory	Interpretation
H1: CSI $\rightarrow$ ER	0.38 ***	Cultural Semiotics (Barthes, 1972)	Authentic symbols evoke emotional connection
H2: AHS $\rightarrow$ DAC	0.44 ***	Hybrid Intelligence (Dellermann et al., 2019)	AI enhances aesthetic consistency
H3: DAC $\rightarrow$ ER	0.31 ***	Emotional Design (Norman, 2004)	Aesthetic harmony elicits emotion
H4: ER $\rightarrow$ PCV	0.49 ***	Product Experience (Desmet & Hekkert, 2007)	Emotion links form and value
H5: PCV $\rightarrow$ CX	0.56 ***	Experience Economy (Pine & Gilmore, 1998)	Cultural value drives satisfaction

Note. *** $p < .001$.

6.0 Conclusion

This study validated the Human–AI Co-Creation Design (HACD) Framework, a comprehensive model demonstrating how human–machine collaboration enhances both design quality and customer experience in the context of traditional cultural products. Drawing on data from 250 participants familiar with Chinese cultural goods, structural equation modeling (SEM) was used to examine relationships among six core constructs: Cultural Symbol Integration (CSI), AI–Human Synergy (AHS), Design Aesthetic Consistency (DAC), Emotional Resonance (ER), Perceived Cultural Value (PCV), and Customer Experience (CX). The findings show that AI–Human Synergy improves aesthetic consistency, highlighting the potential of hybrid creativity, while Cultural Symbol Integration strengthens emotional resonance, emphasizing the role of symbolic authenticity in visual communication. Emotional Resonance mediates the effect of design consistency on Perceived Cultural Value, confirming emotion as a cognitive bridge between form and cultural meaning. Furthermore, Perceived Cultural Value strongly predicts Customer Experience, demonstrating that cultural engagement transforms product satisfaction into meaningful emotional experiences. Collectively, these results indicate that AI–Human Co-Creation enhances design practice by improving aesthetic integrity and facilitating the designer’s ability to express cultural continuity and experiential depth. The findings of this study confirm that Human–AI Co-Creation enhances design practice by strengthening aesthetic integrity (DAC), promoting emotional resonance (ER), and elevating perceived cultural value (PCV). These mechanisms demonstrate how algorithmic assistance and cultural semiotics interact to generate meaningful user experiences.

Figure 3 summarizes the theoretical evolution proposed in this study, illustrating the progression from traditional Human-Centered Design (HCD), characterized by manual processes and intuition, to Human–AI Co-Creation Design (HACD), and ultimately to Intelligent Cultural Design (ICD), where cultural agency and algorithmic ethics converge. The diagonal trajectory in the diagram represents the increasing

integration of human creativity, cultural semiotics, and AI intelligence, highlighting the evolution of creative agency and the deepening of cultural engagement across design paradigms.

Theoretically, this research advances current understanding by empirically demonstrating that emotional resonance serves as a mediating mechanism between aesthetic consistency and perceived cultural value. It extends design theory by positioning emotional cognition as a bridge between computational intelligence and cultural expression within AI-assisted design contexts. Practically, the proposed framework offers actionable insights for designers and design educators. The integration of AI tools such as generative models and visual analytics can facilitate rapid prototyping, enhance design consistency, and support data-driven interpretation of cultural symbols. These applications enable the preservation of traditional aesthetics while promoting adaptive innovation in digital design contexts.

Declarations

Funding

This research received no external funding.

Author Contribution

A. conceptualized the research framework, designed the study, collected and analyzed the data, and wrote the full manuscript. B.C. contributed to critical revision for intellectual content. All authors reviewed and approved the final version of the manuscript.

Data Availability

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

References

1. Anderson, J. C. & Gerbing, D. W. Structural equation modeling in practice: A review and recommended two-step approach. *Psychol. Bull.* **103** (3), 411–423. <https://doi.org/10.1037/0033-2909> (1988).
2. Barthes, R. *Mythologies* (trans: Lavers, Annette) (Hill and Wang, 1972).
3. Brislin, R. W. Translation and content analysis of oral and written materials. In (eds Triandis, H. C. & Berry, J. W.) *Handbook of cross-cultural psychology* (Vol. 2, 389–444). Allyn & Bacon. (1980).
4. Chandler, D. *Semiotics: The basics* (3rd ed.). Routledge. (2017). <https://doi.org/10.4324/9781315725829>

5. Chen, W., Liu, H. & Zhao, Q. Ethical considerations in design research involving online surveys. *Des. Stud.* **78**, 101091. <https://doi.org/10.1016/j.destud.2022.101091> (2022).
6. Choi, Y. Artificial intelligence and cultural creativity: Reinterpreting tradition in design practice. *Des. Issues.* **39** (2), 42–56. https://doi.org/10.1162/desi_a_00706 (2023).
7. Dellermann, D., Ebel, P., Söllner, M. & Leimeister, J. M. Hybrid intelligence. *Bus. Inform. Syst. Eng.* **61** (5), 637–643. <https://doi.org/10.1007/s12599-019-00595-2> (2019).
8. Desmet, P. M. A. & Hekkert, P. Framework of product experience. *Int. J. Des.* **1** (1), 57–66 (2007). <https://www.ijdesign.org/index.php/IJDesign/article/view/66>
9. Gero, J. S. Design computing: AI in design. *Des. Stud.* **72**, 100982. <https://doi.org/10.1016/j.destud.2020.100982> (2021).
10. Hair, J. F., Hult, G. T. M., Ringle, C. M. & Sarstedt, M. *A primer on partial least squares structural equation modeling (PLS-SEM)* 3rd edn (SAGE, 2021).
11. Hall, S. *Representation: Cultural representations and signifying practices* (SAGE, 1997).
12. Hassenzahl, M. *Experience design: Technology for all the right reasons* (Morgan & Claypool, 2010).
13. Holt, D. *How brands become icons: The principles of cultural branding* (Harvard Business, 2004).
14. Kim, S., Park, J. & Lee, J. Designing with AI: Cultural translation and computational creativity. *Leonardo* **54** (5), 482–489. https://doi.org/10.1162/leon_a_01973 (2021).
15. Kline, R. B. *Principles and practice of structural equation modeling* 4th edn (Guilford Press, 2016).
16. Koskinen, I. & Hämmäläinen, M. Artificial intelligence in co-design: Towards hybrid design processes. *CoDesign* **17** (3), 203–219. <https://doi.org/10.1080/15710882.2021.1881774> (2021).
17. Lee, J. & Kim, S. Artificial intelligence in design creativity: Opportunities and challenges. *Int. J. Des.* **16** (3), 1–15 (2022). <https://www.ijdesign.org/index.php/IJDesign/article/view/4510>
18. Li, X. & Zhang, Q. Cultural identity and design innovation in Chinese product packaging. *Des. J.* **23** (6), 847–864. <https://doi.org/10.1080/14606925.2020.1797436> (2020).
19. Li, Y. & Zhao, L. Emotional resonance and cultural authenticity in packaging design. *J. Consumer Behav.* **21** (5), 892–905. <https://doi.org/10.1002/cb.2032> (2022).
20. Norman, D. A. *Emotional design: Why we love (or hate) everyday things* (Basic Books, 2004).
21. Norman, D. A. *Design for a better world: Meaningful, sustainable, humanity-centered* (MIT Press, 2021).
22. Pan, Y. Cultural symbols in modern packaging design: Reinterpreting traditional aesthetics. *She Ji: J. Des. Econ. Innov.* **7** (3), 355–368. <https://doi.org/10.1016/j.sheji.2021.06.007> (2021).
23. Pine, B. J. & Gilmore, J. H. Welcome to the experience economy. *Harvard Business Rev.* **76** (4), 97–105 (1998).
24. Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y. & Podsakoff, N. P. Common method biases in behavioral research: A critical review of the literature and recommended remedies. *J. Appl. Psychol.* **88** (5), 879–903. <https://doi.org/10.1037/0021-9010.88.5.879> (2003).

25. Prahalad, C. K. & Ramaswamy, V. *The future of competition: Co-creating unique value with customers* (Harvard Business School Press, 2004).

26. Shneiderman, B. Human-centered artificial intelligence: Three fresh ideas. *AIS Trans. Hum Comput Interact.* **12** (3), 109–124. <https://doi.org/10.17705/1thci.00131> (2020).

27. Verganti, R., Vendraminelli, L. & Iansiti, M. Innovation and design in the age of artificial intelligence. *J. Prod. Innov. Manage.* **37** (3), 212–227. <https://doi.org/10.1111/jpim.12546> (2020).

28. Zheng, F. Symbolic authenticity and emotional experience in cultural packaging design. *She Ji: J. Des. Econ. Innov.* **9** (1), 22–38. <https://doi.org/10.1016/j.sheji.2022.12.004> (2023).

Figures

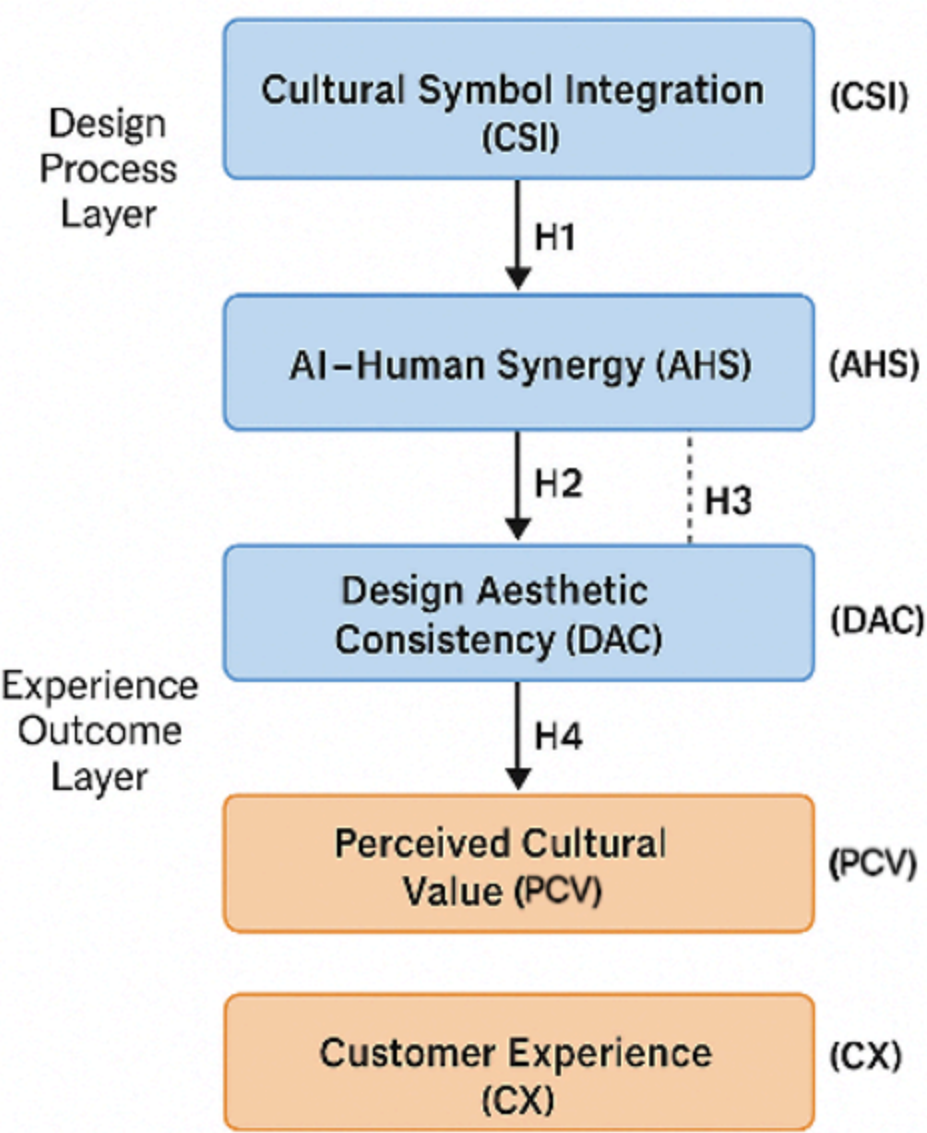


Figure 1

Source by authors

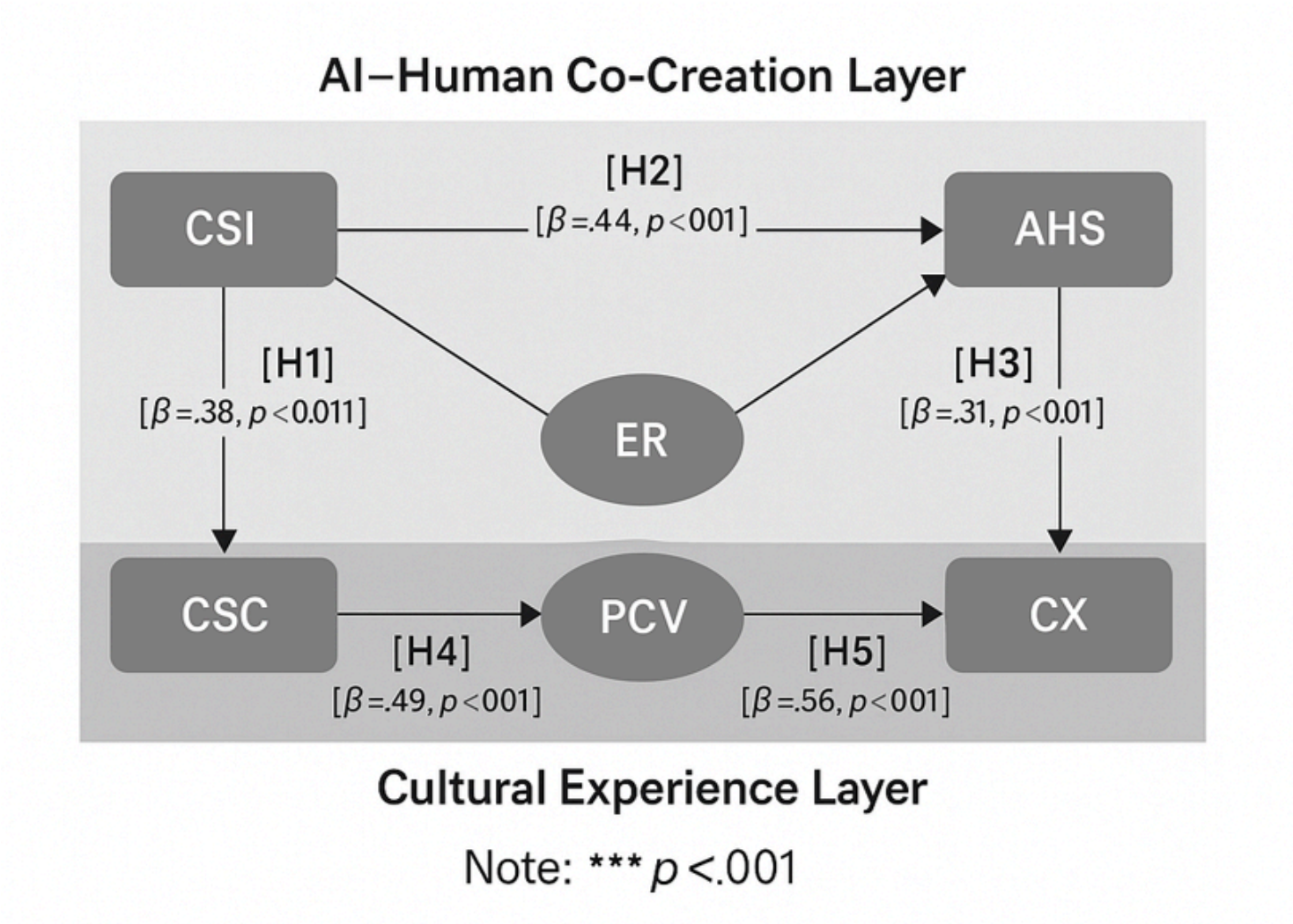
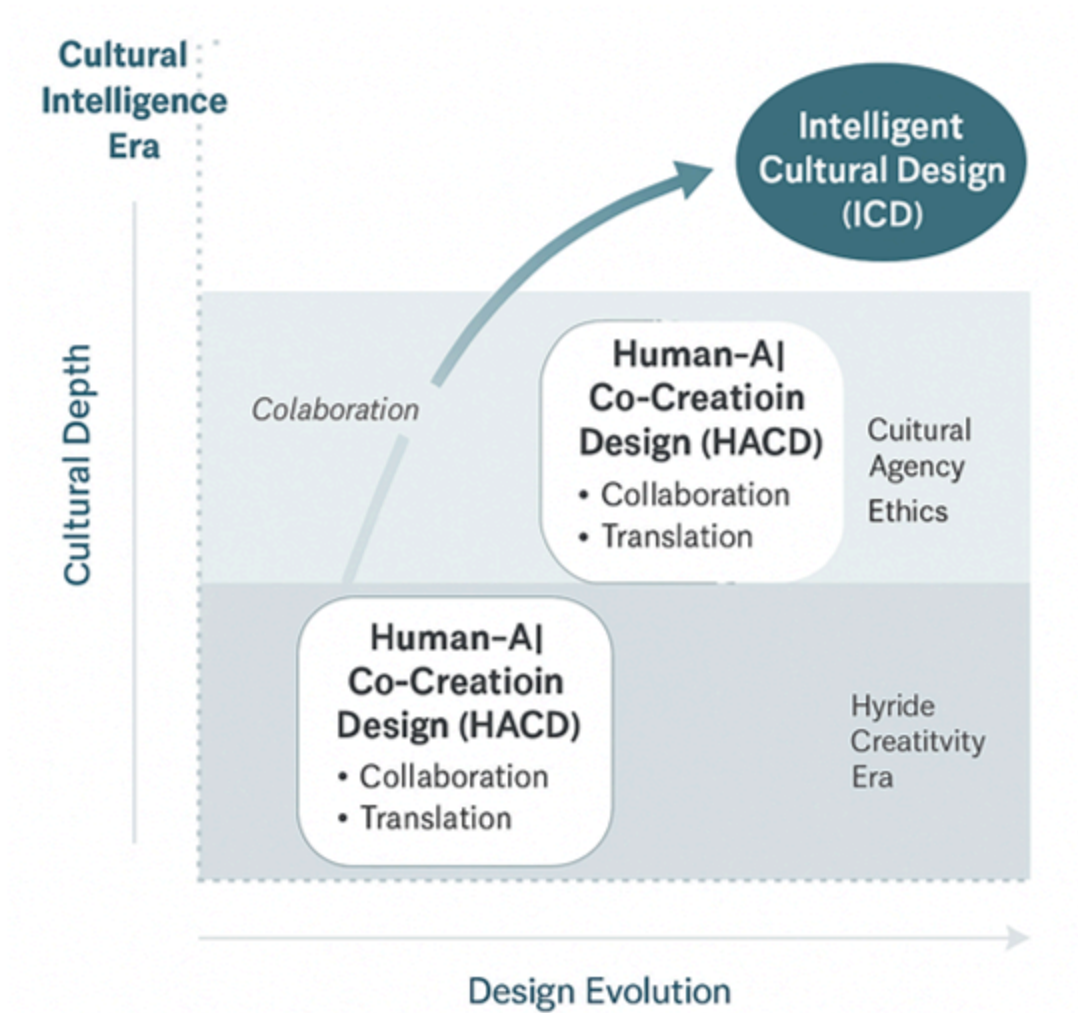


Figure 2

Structural Equation Model (SEM) results with standardized coefficients.



Note: The diagram represents thotheoretical evolution of creative agency and cultural integration.

Figure 3

The Evolution of Human–AI Co-Creation Design (HACD): From Human-Centered to Intelligent Cultural Design