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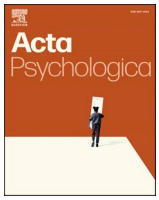

Effects of perceptual, cognitive, and social levels on the aesthetic appreciation of traditional cultural products

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ABSTRACT

Aesthetic appreciation plays a significant role in the success of product design. In empirical aesthetics, previous studies exploring the factors that influence aesthetics mainly focused on one single level using product categories associated with modernization and mass-market consumption. However, aesthetic experience is multilevel and complex, which has been overlooked. Moreover, it remains unclear whether the same aesthetic processing applies to products from traditional culture. Based on the Unified Model of Aesthetics (UMA), this study aims to explore the effects of perceptual, cognitive, and social levels on aesthetic appreciation. To compare with previous studies, Chinese folding screens were used as stimuli, and 213 participants rated them on seven dimensions: unity, variety, typicality, novelty, connectedness, autonomy, and aesthetic pleasure. The results supported that aesthetic appreciation was optimally explained by the combined effect of multilevel aesthetic mechanisms rather than any single level. From the perspective of aesthetic evolutionary psychology, participants preferred aesthetic factors in terms of safety rather than accomplishment. Notably, the social level had the strongest positive influence on aesthetic appreciation, compared with the perceptual and cognitive levels, indicating that social significance shaped aesthetic responses more to culturally rooted products. The findings provide empirical evidence for the multilevel theoretical framework of aesthetic experience and new insights into the aesthetic appreciation of traditional cultural products.

1. Introduction

A substantial body of research in empirical aesthetics has demonstrated that aesthetic appreciation plays a positive and important role in a designed product's success (Bloch, 1995; Post et al., 2016). Not only for traditional artworks, but aesthetic appreciation can also improve user satisfaction, loyalty, and overall preference for any aesthetic object (Schenkman & Jönsson, 2000). Moreover, it affects people's perception of product practicality, usability, and performance (Mridha et al., 2023). Given these beneficial effects, many researchers are interested in trying to understand the determinants and mechanisms associated with aesthetic appreciation (Berghman & Hekkert, 2017; Blijlevens & Hekkert, 2019; Suhaimi et al., 2022) to enhance the aesthetic appeal of designed products.

Recent advances in psychology and cognitive neuroscience emphasize that aesthetic experiences are inherently multilevel, arising from "the Aesthetic Triad", which involves interactions among sensory-motor, emotion-evaluation, and meaning-knowledge neural systems (Chatterjee, 2014; Chatterjee & Vartanian, 2014; Kenett et al., 2023; Shimamura, 2012). When appreciating aesthetic objects, both rapid, bottom-up perceptual processing of physical characteristics (unity and variety) and top-down, controlled cognitive processing (typicality and novelty) may determine the generation of pleasing or displeasing aesthetic evaluations which involves personal experience, learning history, and cultural background (Fechner, 1876; Leder et al., 2004; Miller et al., 2025; Mutter & Hübner, 2024). Additionally, some studies have confirmed that the social information about the relationship between oneself and others conveyed by a product's design attributes, namely connectedness and autonomy, influences aesthetic appreciation (Blijlevens & Hekkert, 2019; Deci & Ryan, 2000). To this end, Hekkert (2014) proposed the unified model of aesthetics (UMA), which integrated previously isolated aesthetic factors into three levels: perceptual, cognitive, and social. The core is to account for the effects of various factors in predicting aesthetic appreciation by balancing the conflicting

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evolutionary motivations and complementary forms of pressure of safety and accomplishment (Berghman & Hekkert, 2017; Hekkert, 2014), thereby constructing a series of aesthetic principles: "Unity-in-Variety" (Post et al., 2016), "Most Advanced, Yet Acceptable" (MAYA) (Hekkert et al., 2003; Suhaimi et al., 2022), and "Autonomous, yet Connected" (Blijlevens & Hekkert, 2019). These multilevel factors work simultaneously to trigger aesthetic appreciation (Berghman & Hekkert, 2017). From the perspective of neuroscience aesthetics, the most complete aesthetic experience is a heightened state in which sensation, knowledge, and emotion (Shimamura, 2012).

However, the interactive and combined effects of perceptual, cognitive, and social levels in predicting aesthetic appreciation remain unclear. To be specific, over the years, empirical aesthetic research has been a series of in-depth but fragmented explorations at a single level, neglecting to simultaneously consider the combined effects of factors across all three levels in shaping aesthetic appreciation. This limitation makes it difficult to explain the complexity of aesthetic experience comprehensively. Furthermore, in addition to evaluation determinants, differences in aesthetic responses to stimuli also exist in terms of individuals (Miller et al., 2025), product categories (Hekkert, 2014), and sociocultural contexts (Hekkert & Leder, 2008; Miller et al., 2025). Previous studies have mainly focused on ordinary product categories associated with modernization and mass-market consumption, including sunglasses and bicycles (Blijlevens & Hekkert, 2019), electronic products (Hashmi et al., 2021), wearable devices (Lee, 2021), and industrial boilers (Suhaimi et al., 2023), overlooking product categories with sociocultural properties. This highlights the necessity of examining stimuli that simultaneously reflect universal aesthetic principles and culture-specific interpretations. Taken together, based on the UMA model, the present study will conduct an empirical investigation by using the product category with the dual properties of universality and cultural diversity - Chinese folding screen - to examine the combined effects of factors across the perceptual, cognitive, and social levels on visual aesthetic appreciation. This consideration, transcending existing isolated factors, provides empirical evidence for theoretical research on comprehensive explanations of aesthetic experiences and new insights for aesthetic studies on traditional cultural products from other countries.

2. Literature review

2.1. The development of aesthetic appreciation

Since the ancient Greek philosopher Plato, beauty has been associated with the perceiver's pleasure. Hekkert (2014) argued that aesthetic appreciation is not an end in itself, but rather stems from the pleasure derived from perceptual understanding, based on which we judge whether we "like" or "dislike" something. From the 19th-century psychophysicist Fechner (1876), who pioneered "aesthetic from below", to Berlyne (1971) and to the present, scientifically systematic empirical aesthetic study has dominated psychological aesthetics, encompassing perceptual, cognitive, and social levels of aesthetic processing. Researchers continue to uncover the nature of aesthetic appreciation using increasingly diverse and representative object examples.

Generally speaking, aesthetic appreciation is generated when people visually encounter various objects surrounding them (Hekkert, 2014; Mridha et al., 2023). These things may be artworks, buildings, products, or artifacts in various forms of entertainment. Early research concentrated on the "high" end (art), including painting, sculpture, and music. It was not until the 1970s that the scope of research gradually expanded to the "low" end - design products, which were described as "everyday aesthetics" by Whitfield and De Destefani (2011). At the beginning of the expansion was landscape aesthetics (Kaplan et al., 1972) and urban aesthetics (Gärling, 1976). Subsequently, Whitfield and Slatter (1979) selected furniture as a stimulus, which initiated aesthetic explorations of everyday objects. In the field of design, in successive studies, Suhaimi et al. (2022) used desktop decorations from purely decorative product categories, and Suhaimi et al. (2023) used industrial boilers from purely utilitarian product categories to explore the effects of typicality and novelty on aesthetic appreciation. More studies have used products that are both decorative and utilitarian: chairs (Loos et al., 2022), espresso machines and lamps (Post et al., 2016) have been used to test unity and variety; clothing products (Ceballos et al., 2021) and wearable devices (Lee, 2021) have been used to explore typicality and novelty; sunglasses and bicycles (Blijlevens & Hekkert, 2019), and electronic products (Hashmi et al., 2021) have been selected to examine connectedness and autonomy. However, to understand aesthetic appreciation more comprehensively, it is necessary to involve as many categories of designed products as possible. Against the backdrop of rapid development in modern society, exploring the design inheritance and innovation of traditional cultural products - those with long-standing historical heritage in specific cultural systems, carrying cultural memory and symbolic meaning, and combining decorative and practical functions - has become particularly important yet overlooked. Unlike ordinary consumer goods or contemporary decorative items, traditional cultural products - such as Chinese folding screens, kimonos, and kilts - are deeply rooted in established cultural scripts and social practices. Consequently, the aesthetic evaluation of these items involves not only perceptual and cognitive processes but also the consideration of their social significance embedded within cultural contexts.

Research on aesthetics in product design has predominantly focused on design determinants, as designers can manipulate these variables directly (Blijlevens et al., 2017). Early Gestalt psychology emphasized that aesthetic perception arises from grasping the overall structure, such as unity and complexity, rather than the simple summation of isolated attributes (Shimamura, 2012). This principle of holistic organization plays a crucial role in aesthetic judgments. Subsequently, psychological aesthetics and cognitive science further indicated that aesthetic experiences rely not only on bottom-up perceptual processing but are also profoundly influenced by top-down cognitive processing involving the viewer's prior experiences, knowledge, and expectations (Molin, 2020; Shimamura, 2012). Berlyne's arousal theory posits that novelty and complexity enhance aesthetic pleasure by eliciting moderate emotional arousal, though the effectiveness of these features depends on the beholder's experiential background (Reber et al., 2004; Tuch et al., 2012). Accordingly, aesthetic evaluation can be conceptualized as a dynamic interaction between stimulus characteristics and an individual's cognitive and emotional systems (Chatterjee & Vartanian, 2014; Mridha et al., 2023).

Research in neuroaesthetics has demonstrated, at the brain mechanism level, that aesthetic experience involves the coordinated activity of perceptual, cognitive, and emotional systems (the Aesthetics Triad), while the contributions of these systems may vary across contexts (Chatterjee & Vartanian, 2014; Shimamura, 2012). Additionally, aesthetic responses exhibit temporal dynamics: initial stages emphasize perceptual processing, while higher-order cognition and social meaning gradually engage as viewing duration increases (Chatterjee & Vartanian, 2014; Redies, 2015). However, recent electroencephalogram (EEG) evidence indicates that the integration of sensory and contextual information is completed within 200–300 milliseconds after stimulus presentation (Noguchi & Murota, 2013), suggesting that an individual's experience, knowledge, and sociocultural background are already engaged in processing even during the first impression stage (Shimamura, 2012). Moreover, research has shown that first impressions and visual attractiveness play a significant role in aesthetic evaluations (Suhaimi et al., 2023; Tuch et al., 2012). Therefore, to focus on the combined mechanisms of perceptual, cognitive, and social levels in overall aesthetic judgments, this study did not manipulate presentation time as a variable.

It is worth noting that within the multidimensional nature of aesthetic experience, culture and product category also moderate the effects of determinants (Hekkert & Leder, 2008). Although certain

aesthetic principles exhibit cross-cultural consistency (Hekkert, 2014) - such as the "Unit-in-Variety" principle rooted in sensory experience - aesthetic experiences remain dependent on the cultural experiences and knowledge backgrounds of specific groups, revealing cultural specificity (Yeh & Peng, 2019). For product categories with deep ethnic cultural connotations, participants from non-consistent cultural backgrounds may perceive all stimuli as highly novel during cognitive processing, thereby obscuring the relative effects of different design features at the perceptual, cognitive, and social levels. Therefore, this study employs an intracultural sample to more accurately examine the effects of multidimensional aesthetic mechanisms in traditional cultural products, filling a gap in the existing literature.

2.2. Safety needs and accomplishment needs

The UMA model framework is bipolar, featuring the conflicting yet complementary "safety side" and "accomplishment side". Grounded in Darwinian evolutionary theory, this aesthetic framework reveals that human aesthetic appreciation of designed artifacts is shaped by the persistent tension between safety and accomplishment needs (Hekkert, 2014; Thornhill, 2003). Motivations for safety and life preservation drive appreciation for unity, typicality, and connectedness; whereas motivations for learning and accomplishment foster appreciation for variety, novelty, and autonomy (Hekkert, 2014). The two seemingly opposing forces are not a simple binary opposition, but rather a dynamic interaction. The optimal point of adaptation and preference often lies in the balance between the two extremes.

At the perceptual level, unity and variety embody two opposing forces. Humans prefer unity and order, which simplify and streamline perceptual processing, reducing uncertainty and benefiting survival and safety. On the other hand, humans actively seek variety in their surroundings to stimulate the senses and heighten interest (Berlyne, 1971; Post et al., 2017), thereby enhancing their ability to cope with the environment. However, Post et al. (2017) noted that perceiving variety alone leads to fragmented, incoherent perceptions, resulting in overstimulation. Therefore, the moderate integration of unity (safety) and variety (accomplishment) has the most evolutionary advantage, namely "Unity-in-Variety" (Loos et al., 2022; Post et al., 2016).

At the cognitive level, typicality facilitates categorization and comprehension, reducing cognitive effort and perceived risk. Typical objects evoke familiarity, enabling individuals to avoid potential harm. Novelty, conversely, signals learning opportunities and potential value. Berlyne (1971) posited that human intrinsic motivation lies in exploring new things or acquiring new information. Regarding the opposing variables of typicality and novelty, many studies suggest that product designs with an optimal combination of typicality (beneficial for safety) and novelty (promoting accomplishment) are most preferred, namely "Most Advanced, Yet Acceptable" (MAYA) principle (Ceballos et al., 2019; Hekkert et al., 2003). For instance, research by Thurgood et al. (2014) on lamps and clocks confirmed that products with an optimal balance between typicality and novelty in design are most preferred.

At the social level, the optimal aesthetic appreciation results from an optimal balance between connectedness (safety) and autonomy (accomplishment), namely "Autonomous, yet Connected" (Blijlevens & Hekkert, 2015, 2019). For example, Chan et al. (2012) demonstrated that consumers select brands that make them feel closely connected to their social group (e.g., BMW or local brands), then choose product designs from that brand that make them feel unique in their group (e.g., red or black) (Chan et al., 2012). Therefore, the aesthetic appreciation of products reflects not only a reliance on safety but also a pursuit of accomplishment, which has evolved into a need for balanced security (Berghman & Hekkert, 2017). The relationships and interactions between these opposing variables across various levels are the focus of this study.

The UMA model explains why we appreciate specific designs or artworks aesthetically through a series of conflicting needs for safety and accomplishment (Thornhill, 2003). The success of a species depends on its adaptation to the environment. Seeking safety comes with inherent risks, while exploring accomplishment requires a sufficient foundation of safety (Berghman & Hekkert, 2017). Hekkert (2014) suggested that people generally prefer the "safety side" (unity/typicality/connectedness) of high-risk product categories and the "accomplishment side" (variety/novelty/autonomy) of high-safety product categories. Kaplan et al. (1974) hold that products with stronger social significance often carry higher perceived risk. For traditional cultural products carrying symbolic meaning and identity, deviations from conventional forms may be perceived as non-compliant with social norms or undermining cultural authenticity (An et al., 2022). In contrast, perceived unity, cognitive typicality, and connectedness support cultural continuity, recognizability, and group association. In other words, the prominence of safety-side factors may reflect the intrinsic value placed on familiarity, recognizability, and cultural resonance rather than perceived risk alone. Taken together, these findings suggest that when considering traditional cultural products with deep cultural symbolism and social functionality, people tend to focus more on the "safety side" - unity, typicality, and connectedness.

2.3. Unified model of aesthetics (UMA model)

The UMA model is a structured, comprehensive aesthetic framework comprising three independent yet interdependent levels - perceptual, cognitive, and social - that unifies existing aesthetic theories across multiple fields, including cognitive psychology, social psychology, design, cognitive neuroscience, philosophy, and art (Hekkert, 2014). Such multidisciplinary approaches in aesthetic science precisely meet the shared aspirations of philosophers, psychologists, and neuroscientists. By integrating resources across fields, it provides a comprehensive perspective for understanding the aesthetic mechanisms. Research in neuroaesthetics has shown that when encountering aesthetic objects, complex psychological processes activate numerous brain regions working jointly to process sensory signals, link sensory information with existing cognition, and extract emotional meaning (Chatterjee & Vartanian, 2014; Shimamura, 2012). By accumulating empirical research, the UMA aesthetic framework attempts to reveal the complex and multidimensional nature of aesthetic experience through efficient perceptual input, experiential cognitive processing, and the social meaning of emotional interaction (Berghman & Hekkert, 2017). Taken together, factors across the perceptual, cognitive, and social levels (unity, variety, typicality, novelty, connectedness, and autonomy) may activate the neural systems (sensory-motor, meaning-knowledge, emotion-evaluation) in different ways, thereby influencing aesthetic experience. To be specific, these factors may act at least partially or simultaneously and interactively in the aesthetic appreciation of a designed product (Berghman & Hekkert, 2017), though not necessarily with equal weight (Chatterjee & Vartanian, 2014; Kenett et al., 2023; Shimamura, 2012).

2.3.1. Unity and variety at the perceptual level

The earliest focus of empirical aesthetics in psychology was on the perceptual characteristics of objects (Post et al., 2016). Perception is a direct response to sensory input. When individuals perceive an object's properties, stimulation-driven processing occurs immediately, generating instantaneous aesthetic evaluations of pleasing or displeasing qualities (Hekkert & Leder, 2008; Leder et al., 2004).

At the perceptual level of the UMA model, unity and variety manifest as initial responses to sensory input. Unity refers to the perceived order and coherence among design attributes and elements (Berlyne, 1971; Post et al., 2016). Scholars have argued that aesthetic appreciation arises from perceived unity (Post et al., 2016; Tyan-Yu et al., 2017), as fluent perceptual processing contributes to a sense of safety. Loos et al. (2022) performed a topological optimization on the shapes of chairs and cantilever beams, revealing that increasing unity is a key factor in

regulating product aesthetics. Tyan-Yu et al. (2017) held the same view through their studies that compared to products with lower unity, those with higher unity tended to evoke stronger pleasurable responses. However, an excessive pursuit of unity can lead to sensory dullness. Some scholars have argued that variety, generated from differences among perceptual elements, also stimulates the senses and enhances interest (Berlyne, 1971). Post et al. (2017) conducted experiments by separately controlling unity (manipulating symmetry) and variety (manipulating color), and the results confirmed that variety has a greater impact on aesthetic appreciation compared to unity.

Unity and variety are opposites to each other but interdependent. Early in ancient Greece, the "Unity-in-Variety" aesthetic principle was influential (Berlyne, 1971; Fechner, 1876), described as the balance between unity and variety in visual form. According to neuroscience's predictive coding theory (Chatterjee & Vartanian, 2014), aesthetic pleasure arises when sensory input strikes a balance between predictability and information gain. Excessive unity minimizes prediction errors but leads to perceptual dullness, while excessive variety overburdens prediction errors and causes perceptual incoherence. The neurocomputational perspective provides a mechanistic explanation for the "Unity-in-Variety" principle (Post et al., 2016; Van de Cruys & Wagemans, 2011). Subsequent scholars have confirmed through studies on designed products that aesthetic appreciation arises from an appropriate balance between unity and variety (Logkizidou, 2021; Post et al., 2016; Van Geert & Wagemans, 2020). A lack of variety does not always lead to a product being completely unappreciated, but a lack of unity can cause sensory confusion and incomprehension (Post et al., 2017). In addition, since the trade-off between unity and variety stems from sensory experience, its influence on aesthetic appreciation is culture-consistent (Miller et al., 2025). In other words, this aesthetic response elicited by early perceptual processing equally applies to explaining product categories with traditional culture.

However, this rapid perceptual processing of low-level stimulus features does not involve cognitive experience, and it is not easy to make further explanations in aesthetic appreciation. Post et al. (2016) found unexpected results when examining the aesthetic appreciation of tables, predicting that the relatively minor importance of variety may depend on typicality or novelty at the cognitive level. Therefore, aesthetic experience cannot be explained by just one level.

2.3.2. *Typicality and novelty at the cognitive level*

Following perceptual processing comes "higher-level" cognitive processing, which involves conscious mental processing, including categorization, association, memory, or evaluation of more complex information. Unlike perceptual processing, at the cognitive level, the typicality and novelty of stimuli involve comparisons in terms of the viewer's experience, knowledge, and sociocultural background (Miller et al., 2025; Mutter & Hübner, 2024). Therefore, novelty must be based on familiar things. The arousal theory proposed by Berlyne (1971) posited that novel stimuli evoke aesthetic pleasure by increasing arousal levels and stimulating interest. Several product studies have confirmed the positive influence of novelty on aesthetic appreciation (Althuizen, 2021; Mridha et al., 2023; Suhaimi et al., 2023). In contrast, some studies have shown that people prefer familiar or typical objects in stimulus categories, such as furniture (Whitfield & Slatter, 1979), toothbrushes and mice (Yahaya, 2017), and apparel (Ceballos et al., 2020). Familiarity fosters a sense of safety by preventing potential harm, while typicality offers a sense of cognitive ease.

Overall, both typicality and novelty positively influence aesthetic appreciation. Loewy (1951) first proposed the MAYA principle, advocating for an optimal balance between typicality and novelty. Based on this, several researchers have confirmed that the optimal integration of both elements in product design maximizes aesthetic pleasure (Ceballos et al., 2019; Hekkert et al., 2003). Most studies focus on exploring the cognitive factors, such as typicality and novelty, that affect aesthetic appreciation, especially their relationship. Since cognitive processing depends on previous experience and cultural background, typicality and novelty may have different effects on the aesthetic processing of traditional cultural products.

2.3.3. *Connectedness and autonomy at the social level*

For the social level, culture, identity, brand symbolism, and group norms all influence aesthetic judgments. Blijlevens and Hekkert (2019) indicated that product design generally reflects social trends, and consumers tend to choose designs that align with their cultural background or social identity. Although earlier research in social psychology and sociology (Bloch, 1995; Bourdieu, 1993) emphasized the important role of social concerns in influencing consumers' aesthetic appreciation of product design, few studies focused on the role of connectedness and autonomy at the social level.

Generally speaking, aesthetic judgment is not an isolated outcome. At the social level, a designed product as a social cue plays a significant role in many interactions between people and the world. Consumers use product design to infer social information about their relationships with others (Blijlevens & Hekkert, 2019). On one hand, people seek to establish a sense of connection with others (Deci & Ryan, 2000) and maintain belonging to a group that conforms to their expectations. On the other hand, people desire to be regarded as unique and distinct within the groups to which they belong, reflecting a need for autonomy (Blijlevens & Hekkert, 2015). Therefore, the prediction of optimal aesthetic pleasure refers to the principle of "Autonomous, yet Connected": when product design achieves the optimal balance between the seemingly conflicting needs for connectedness and autonomy, it will bring the highest aesthetic appreciation (Blijlevens & Hekkert, 2015, 2019). Blijlevens and Hekkert (2019) selected sunglasses, bicycles, and staplers as stimuli. They found that both connectedness and autonomy positively impacted aesthetic preference for product design, confirming and establishing the "Autonomous, yet Connected" social design principle.

However, the transformation of the dynamic balance between connectedness and autonomy depends on the degree of social risk associated with the product category (Blijlevens & Hekkert, 2019). Social risk refers to the degree to which choosing a product "may affect how others perceive you" (Kaplan et al., 1974). People's concern for autonomy decreases when a product category provides sufficient safety. When a product category manifests a high degree of social risk, connectedness has a stronger influence on aesthetic appreciation than autonomy. For example, Blijlevens and Hekkert (2019) confirmed that backpacks are product categories with sufficient social safety levels, in which reduced social risk leads people to choose lower autonomy. Conversely, fashion sneakers and sunglasses - as high-social-risk product categories - showed that connectedness had a stronger effect than autonomy in explaining aesthetic appreciation. Accordingly, the symbolic meaning and cultural connotations of traditional cultural products imply a high degree of social risk associated with them, because choices involving culturally meaningful artifacts may signal group identity, cultural affiliation, or aesthetic norms to others. It is predicted that connectedness will be dominant at the social level.

In summary, the existing evidence has shown that aesthetic appreciation is a complex psychological process that engages extensive neural networks and involves coordinated activity across multiple brain regions. It typically involves a bottom-up and top-down combined evaluation of object features (Iigaya et al., 2021; Miller et al., 2025). Interacting with designed products triggers aesthetic responses characterized by multilevel dynamic integration of perceptual, cognitive, and social factors (Berghman & Hekkert, 2017). The three levels interact in a specific product, where the influence of one level on aesthetic appreciation is affected by another level (Berghman & Hekkert, 2017; Hekkert, 2014). The interaction between these three levels is the core of the UMA model. Unity and variety at the perceptual level serve as initial "lower-level" sensory inputs for attributes, followed by "higher-level" processing at the cognitive level, where typicality and novelty further interpret

and assign meaning to these attributes. The social level embeds these characteristics within group relationships and cultural contexts, deepening the aesthetic experience while in turn influencing cognitive and perceptual processing. In other words, the perceptual level provides the foundation for aesthetic appreciation, the cognitive level deepens the aesthetic processing, and the social level gives it broader contextual meaning.

Therefore, each level independently influences aesthetic appreciation in its specific way (Berghman & Hekkert, 2017). In turn, these three levels are interconnected and contribute jointly to the overall appreciation of designed products, which provide a comprehensive perspective on the complexity and diversity of aesthetic appreciation, transcending the explanatory power of any single level. Nevertheless, few studies have explored the aesthetic appreciation of product design from this comprehensive perspective of multiple levels acting simultaneously. Additionally, according to Blijlevens and Hekkert (2019), for product categories with lower social significance, the perceptual or cognitive level may play a more prominent role in explaining aesthetic appreciation, whereas for product categories with greater social significance, the social level may emerge as stronger influences. Importantly, the fact that a product is a culturally embedded traditional object does not imply that social-level predictors will necessarily dominate aesthetic responses. For traditional cultural products, differences persist in perceptual organization (unity and variety) and cognitive characteristics (typicality and novelty). Therefore, whether the influence of the social level is stronger than that of the perceptual or cognitive levels remains an empirical question. This study will test these hypotheses using traditional cultural product categories to provide theoretical support and practical guidance for cultural product design and aesthetic research.

Based on the above, this study proposes the following hypotheses:

H1. For the aesthetic appreciation of Chinese folding screen designs, a multilevel model that integrates predictive factors across the perceptual, cognitive, and social levels has a stronger explanatory power than any single level.

H2. The “safety side” features in the UMA model are preferred for the Chinese folding screen designs with traditional culture.

H3. The social level has the strongest effect on the aesthetic appreciation of Chinese folding screen designs.

3. Methods

3.1. Ethics

The experiment for this study was an offline survey approved by the Malaysian ethics committee. The Ethics Committee for Research involving Human Subjects found that there were no objectionable ethical issues involved in the proposed study.

3.2. Stimuli

Ten visual images of Chinese folding screens were meticulously selected through three stages: (a) assembling an initial stimulus image pool; (b) 12 researchers (4 in empirical aesthetics, 4 in psychology, 4 in industrial design) independently selecting images they considered to represent high, medium, and low levels of unity, variety, typicality, novelty, connectedness, and autonomy; and (c) the research team comparing and discussing their differences.

Initial stimulus image pool. Furniture products were chosen for this study because previous empirical research in aesthetics has established them as a reliable stimulus category for evaluating aesthetic pleasure (Hung & Chen, 2012; Tyagi, 2017; Whitfield & Slatter, 1979). In contrast to studies by Hung and Chen (2012), Thai (2019), and Tyagi (2017) focusing on modern furniture categories, this study selected Chinese furniture with rich traditional cultural connotations. The aim is to test whether the product's cultural value influences differences in aesthetic responses across levels. Furthermore, Chinese folding screens themselves serve as both inheritors and recorders of Chinese historical and traditional culture (Hong & Li, 2020) and are widely used as everyday furniture, integrating functionality, aesthetics, and sociocultural connotations, making them highly valuable for aesthetic research. To this end, one researcher selected approximately 80 varied Chinese folding screen designs from the internet for subsequent selection and rating.

The research team screened stimulus samples. Drawing on existing literature (Blijlevens & Hekkert, 2019; Suhaimi et al., 2023; Tyagi, 2017), this study focused on shape as a variable in visual stimuli. Previous experiments on the UMA model did not specify a fixed number of stimuli, ranging from 2 (Blijlevens et al., 2012), 5 (Ceballos et al., 2020), 7 (Suhaimi et al., 2023), to 12 (Thurgood et al., 2014). Therefore, this study independently selected and collaboratively compared 10 Chinese screen image samples through group deliberation. The shape design features of these stimuli describe varying degrees of unity, variety, typicality, novelty, connectedness, and autonomy, serving for simultaneous evaluation across perceptual, cognitive, and social aesthetic levels. Following Whitfield and Slatter's (1979) stimulus guidelines, each stimulus image displayed on the questionnaire page maintained a consistent perspective and had color removed via image processing to ensure visual consistency. All images were resized to 10 cm along their vertical dimension while preserving their original aspect ratio. In addition, in order to avoid interference from brand recognition and price factors, the label was removed. Previous studies have shown that the background in which the stimulus is placed in the experiment affects the participants' judgment of the typicality and novelty of the stimulus (Suhaimi et al., 2023). Given this, the stimulus image itself was presented separately, and its display background was unified to white. The final presentation is shown in Fig. 1.

3.3. Participants

Effective aesthetic evaluation of products with traditional cultural connotations depends on individuals' cultural backgrounds, prior knowledge, and familiarity with relevant stimuli (Mutter & Hübner, 2024; Suhaimi et al., 2023). Therefore, to ensure participants sufficiently understand the cultural context embedded in Chinese folding screens, this study recruited participants from mainland China, including native Chinese-speaking students, teaching staff, and the public. Due to non-culturally consistent samples, it may affect individuals' effective interpretation of stimulus design features (Hekkert, 2014).

During the recruitment process, we tried to consider a broader range of participants with different academic or experience backgrounds. However, according to Whitfield (2007), art or design professionals do not represent the general public, particularly as they tend to make biased aesthetic judgments based on their expertise. Therefore, on-site surveys explicitly stated that individuals with art or design experience and expertise, as well as participants under 18 years of age, were ineligible to participate. Meanwhile, the survey questionnaire collected participants' professional backgrounds and ages to screen for invalid responses during subsequent analysis.

The participant sample size was determined based on previous relevant studies (Blijlevens & Hekkert, 2019; Ceballos et al., 2020; Post et al., 2016; Suhaimi et al., 2023), with an average of 200 or more participants. Ultimately, 265 participants were successfully recruited from two universities in China. A total of 52 samples were excluded due to incomplete data ($n = 23$), lack of seriousness in completing the questionnaire (e.g., consistently straight-line or patterned responses on Likert scale questions, $n = 10$), or backgrounds in art or design ($n = 19$). A total of 213 valid questionnaires met the study requirements. Participants included 108 males (50.7%) and 105 females (49.3%), resulting

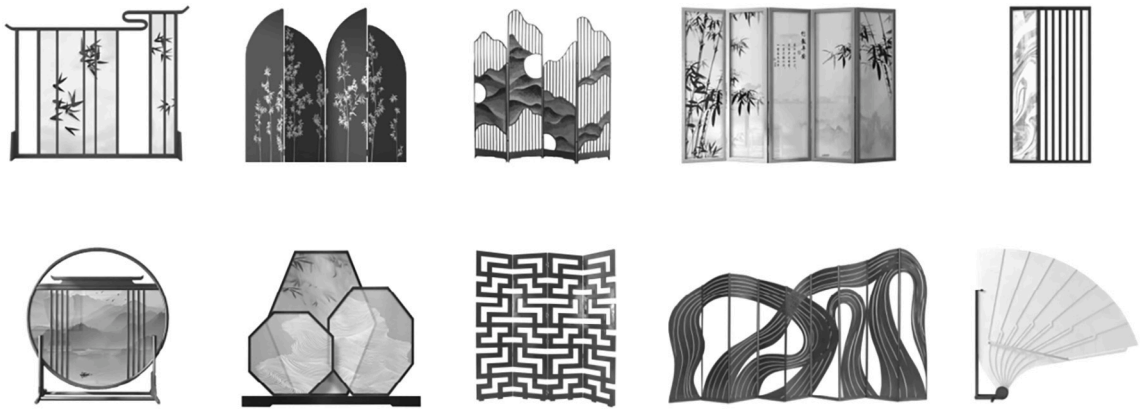

Fig. 1. The final stimuli images of ten chinese folding screens are being standardized for study.

in a balanced gender distribution. Age was queried using predefined ranges rather than exact numerical values. As the questionnaire was distributed on two university campuses in China, the majority of participants were aged 18 to 25 (62.4%, $n = 133$), followed by those aged 26 to 35 (14.1%, $n = 30$) and 36 to 45 (19.2%, $n = 41$). All participants were at or above the college level in education.

3.4. Procedures

An offline survey was conducted face-to-face on several Chinese university campuses as part of a public academic lecture. The research protocol has been approved by the ethics review of Malaysia. Before the offline survey, the researchers must apply for and obtain permission from the university institutions where the survey is to be conducted. Recruiting participants, distributing, and collecting informed consent forms and paper-based questionnaires were done with the assistance of the university staff.

As an initial step in the survey, voluntary participants signed informed consent forms, followed by completing paper-based questionnaires. The first section of the paper-based questionnaire consisted of demographic questions for data screening, including participants' gender, age, professional background, and education level.

Subsequently, the second section required participants to conduct a visual aesthetic evaluation of Chinese folding screens. They viewed 10 images of Chinese folding screens one by one. To eliminate order effects, we randomized the presentation sequence of stimulus images in advance. For each participant, we generated a unique random sequence using the random sequence generator at https://www.random.org/sequences/. Following this, we printed the ordered questionnaires one by one for distribution at the survey site.

Each page displayed only one stimulating image, accompanied by the same set of individual statements for each level of aesthetic appreciation. Participants' agreement with these statements was rated using a 7-point Likert scale (from 1 = "strongly disagree" to 7 = "strongly agree"). The statements covered six core dimensions from three levels of aesthetic characteristics: the perceptual level measures of "unity" and "variety", and the cognitive level measures of "typicality" and "novelty", derived from the universal aesthetic scale validated by Blijlevens et al. (2017); the social level measures of "connectedness" and "autonomy" were derived from the valid and universal aesthetic scale validated by Blijlevens and Hekkert (2019). In addition, another statement was used to assess the aesthetic pleasure of Chinese folding screens (This design is pleasing to see.), which has been validated in previous studies (Blijlevens et al., 2017; Blijlevens & Hekkert, 2019). The paper questionnaire was drafted in English, and the Chinese version was distributed to participants at the survey site. To this end, professional translators were hired to translate and proofread to ensure the accuracy of sentences and important terms, as well as the fluency of reading.

To ensure participants effectively understood the design concepts underlying each measure, we referenced representative wording validated during scale development by previous research (Blijlevens et al., 2017; Blijlevens & Hekkert, 2019). For example, "unity" was interpreted as "orderly, coherent", while "typicality" was defined as "standard, common, and representative." These interpretations were detailed in Table 1. Before the formal rating, this table was presented to participants to help them understand the rating task.

Table 1
Statements and representative phrasing of each aesthetics scale.

Item	Scale Statement	Representative Phrasing
Unity	This is a unified design.	This is an orderly design. This is a coherent design.
Variety	This design conveys variety.	This design is rich in elements. This design is made of different parts.
Typicality	This is a typical design.	This is a standard design. This design is common. This is characteristic of a Chinese folding screen. This is a representative design.
Novelty	This is a novel design.	This is a new example design. This design is innovative. This design is original.
Connectedness	This product design makes me feel connected to my type of people.	This product design makes me feel affiliated with my type of people. This product design makes me belong to my type of people. This product design shows that I am similar to my type of people. This product design helps to be accepted by my type of people.
Autonomy	This product design helps to emphasize my individuality towards my type of people.	This product design helps me to be unique towards my type of people. This product design helps to distinguish myself from my type of people. This product design communicates to my type of people that I do my own thing. This product design shows that I do things differently from others.
Aesthetic Appreciation	This design is pleasing to see.	I like to look at this design. This is an attractive design. This is a beautiful design. This design is nice to see.

4. Results

The collected data were analyzed using social statistics software (IBM SPSS Statistics 26). Repeated Measures Analysis of Variance (ANOVA) was conducted to examine differences in aesthetic appreciation of 10 Chinese folding screens among participants. The screens served as the within-subjects factor, with the ""Pleasing to see" scale as the dependent variable. For summary and comparison, the bar chart (Fig. 2) presents the estimated marginal means for the aesthetic appreciation scale across the 10 stimuli, ranked from highest to lowest. Screen No. 1 was rated highest (M = 5.53), suggesting it was the most preferred by participants, while Screen No. 10 was rated lowest (M = 3.50). Bar charts in Fig. 3, Fig. 3(a) - (f) present the differences rated on the scales of unity, variety, typicality, novelty, connectedness, and autonomy, respectively. The results indicated that no Chinese screen that rated highly on aesthetic appreciation scored low (≤ 3 units) on any of the six design characteristics: unity, variety, typicality, novelty, connectedness, or autonomy. In contrast, the stimulus with the highest aesthetic appreciation received high scores (> 4.5 units) on all six design characteristics. Numerical labels at the base of each bar chart indicate the precisely estimated marginal means, and the error bars at the top represent the 95% confidence intervals, providing a clear overview of differences in aesthetic appeal across the ten screens for subsequent multilevel analysis.

As a preliminary exploratory analysis, Pearson correlation analysis was conducted to examine the direction and strength of correlations among the six design features (unity, variety, typicality, novelty, connectedness, autonomy) and between these features and "Pleasing to see"(aesthetic appreciation). Given the repeated-measures design of this study, to satisfy the independence assumption, data were aggregated at the participant level before conducting the Pearson correlation analysis. Table 2 reports the correlation coefficients and corresponding 95% confidence intervals. Results indicated that all six design features showed significant positive correlations with aesthetic appreciation ($r_{unity} = 0.823$, $r_{variety} = 0.436$, $r_{typicality} = 0.889$, $r_{novelty} = 0.460$, $r_{connectedness} = 0.969$, $r_{autonomy} = 0.529$, all $P < 0.01$), with correlation coefficients ranging from moderate to strong ($r = 0.4$–0.9) (Cohen, 1988). Regarding the direction and strength of correlations among variables, there were significant positive correlations between "safety side" aesthetic factors ($r_{unity \times typicality} = 0.984$, $r_{unity \times connectedness} = 0.869$, $r_{typicality \times connectedness} = 0.937$, all $P < 0.01$), with strong associations. Similarly, "accomplishment side" aesthetic factors also showed significant positive correlations ($r_{variety \times novelty} = 0.936$, $r_{variety \times autonomy} = 0.965$, $r_{novelty \times autonomy} = 0.858$, all $p < 0.01$), with strong correlations. Additionally, unity and typicality showed significant negative correlations with variety, novelty, and autonomy, respectively (all $p < 0.05$), consistent with the distinction between the safety and accomplishment dimensions in the UMA model. In contrast, the correlations between connectedness and variety ($r = -0.564$, 95% CI [−0.895, −0.063], $p = 0.09$) and between connectedness and novelty ($r = -0.513$, 95% CI [−0.847, 0.188], $p = 0.129$) did not reach statistical significance.

To test whether a multilevel model integrating predictors from perceptual, cognitive, and social levels explains aesthetic appreciation of Chinese folding screens better than any single-level model, three nested linear mixed-effects models were constructed:

M1 (Perceptual level only): unity and variety;

M2 (Perceptual + Cognitive levels): unity, variety, typicality, and novelty;

M3 (Multilevel model): unity, variety, typicality, novelty, connectedness, and autonomy.

As shown in Table 3, model fit significantly improved with added levels. More specifically, incorporating cognitive-level predictors (M2 vs. M1) significantly enhanced model fit ($\Delta\chi^2 = 302.189$, df = 2, $p < 0.001$). The integration of social-level predictors (M3 vs. M2) further significantly enhanced model fit ($\Delta\chi^2 = 520.862$, df = 2, $p < 0.001$). Likelihood ratio tests indicated that the full multilevel model (M3) showed significantly better fit than models containing only one or two levels (−2LL(M3) < −2LL(M2) < −2LL(M1)). These results suggest that each conceptual level provides an incremental contribution to explaining differences in aesthetic appreciation, and that the combined explanatory power of perceptual, cognitive, and social factors exceeds that of any single level. Therefore, H1 is supported. Although correlations between predictors across levels were observed, the nested model comparisons indicate that adding predictors from each level significantly improved model fit. This suggests that perceptual, cognitive, and social predictors are conceptually distinguishable, even if they are not fully independent in a statistical sense.

To test whether the design features on the "safety side" of the UMA

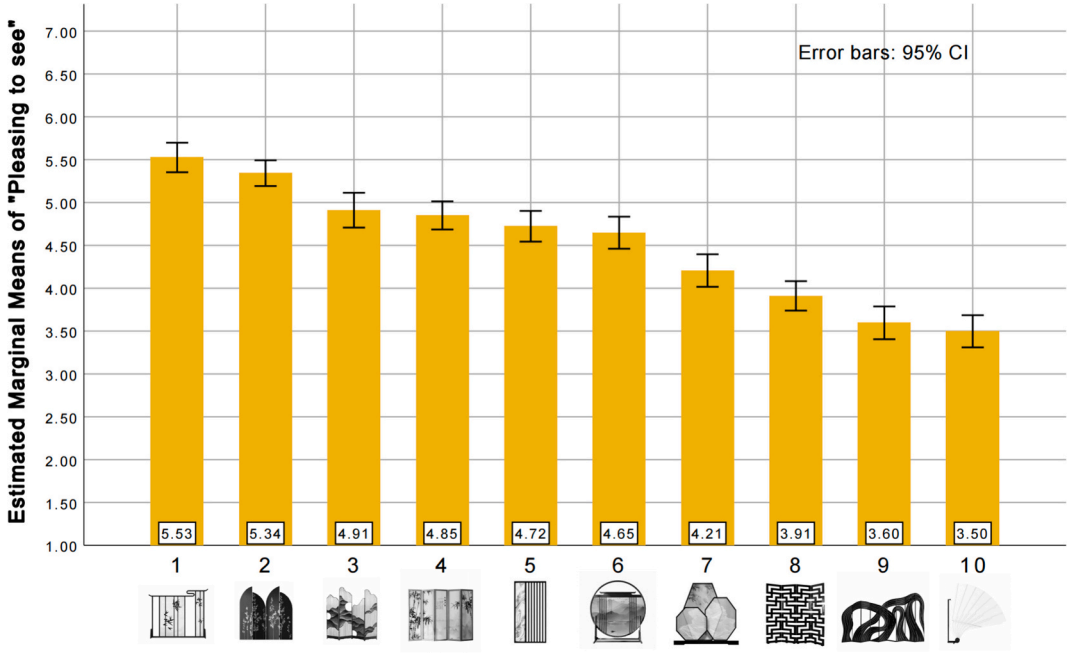

Fig. 2. Estimated marginal means for the "Pleasing to see" scale of each stimulus.

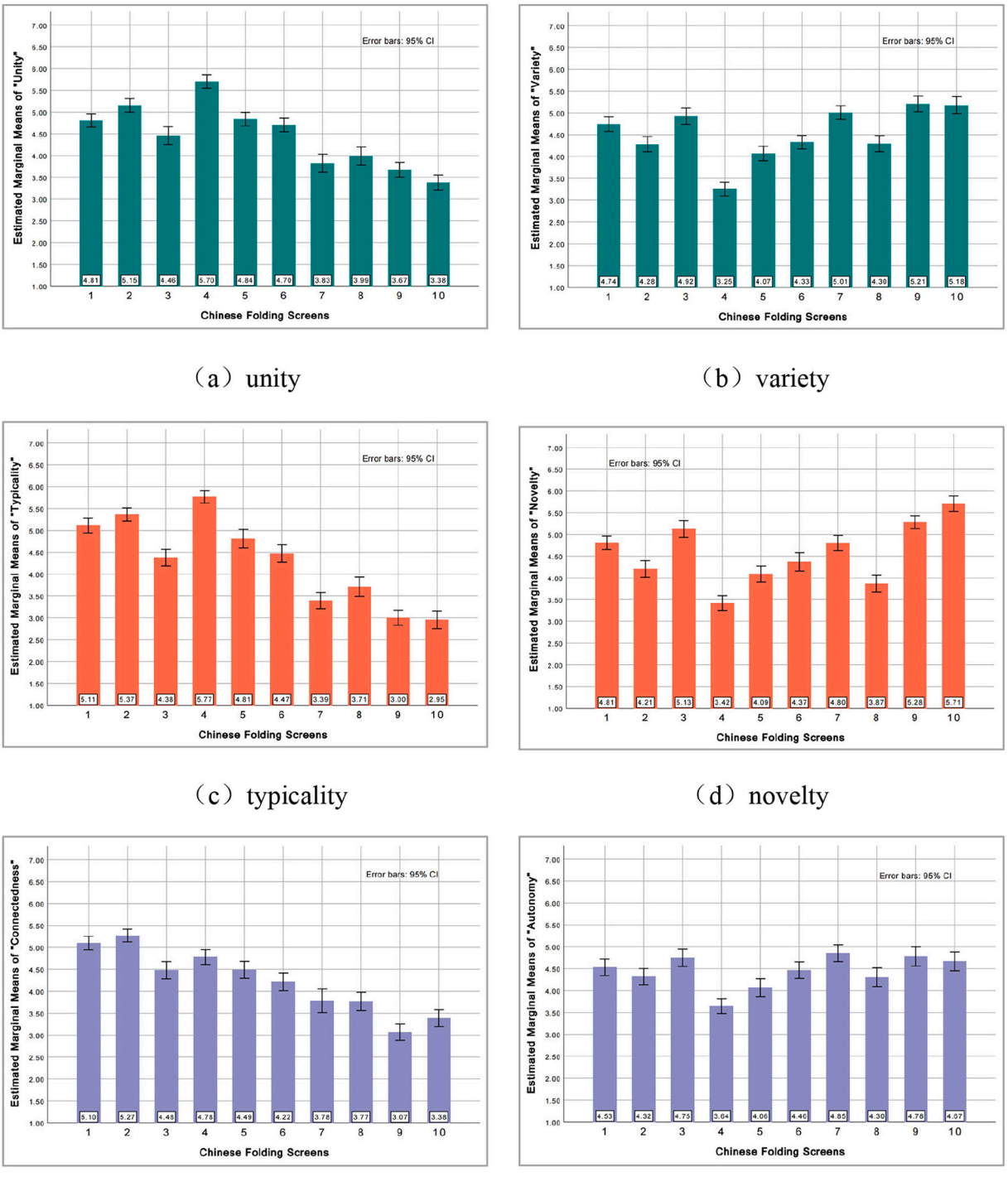

Fig. 3. Estimated marginal means for “unity”, “variety”, “typicality”, “novelty”, “connectedness” and “autonomy” scales of each stimulus.

model are preferred over those on the “accomplishment side,” all six predictors were standardized to allow direct comparison of regression coefficients. This involved constructing a safety composite (unity, typicality, connectedness) and an accomplishment composite (variety, novelty, autonomy). Both composites were simultaneously entered as fixed effects in the linear mixed-effects model to predict aesthetic appreciation. Results showed that both composites significantly predicted aesthetic appreciation ($p < 0.001$), as presented in Table 4. Importantly, compared to the positive effect of the achievement composite ($B = 0.611$, $SE = 0.034$, 95% CI [0.544, 0.677], $p < 0.001$), the safety composite variable had a stronger positive effect ($B = 1.255$, $SE = 0.033$, 95% CI [1.189, 1.320], $p < 0.001$). Additionally, a contrast variable representing the difference between the safety and accomplishment effects (safety-accomplishment) was calculated and entered into a separate linear mixed-effects model. Consequently, the contrast variable significantly predicted aesthetic appreciation ($B_{\text{safety-accomplishment}} = 0.336$, $SE = 0.025$, 95% CI [0.287, 0.385], $p < 0.001$), further confirming that safety factors had a stronger influence on aesthetic

Table 2
Pearson correlation coefficient analysis results.

Variable	Pleasing to See	Unity	Variety	Typicality	Novelty	Connect-edness	Auton-omy
Pleasing to See	1						
Unity	0.823** [0.506, 0.967]	1					
Variety	0.436** [0.312, 0.543]	−0.841** [−0.961, −0.464]	1				
Typicality	0.889** [0.685, 0.982]	0.984** [0.963, 0.997]	−0.784** [−0.959, −0.365]	1			
Novelty	0.460** [0.352, 0.564]	−0.748* [−0.970, −0.269]	0.936** [0.877, 0.991]	−0.695* [−0.944, −0.268]	1		
Connectedness	0.969** [0.934, 0.990]	0.869** [0.688, 0.973]	−0.564 [−0.895, −0.063]	0.937** [0.842, 0.988]	−0.513 [−0.847, 0.188]	1	
Autonomy	0.529** [0.421, 0.614]	−0.774** [−0.935, −0.358]	0.965** [0.862, 0.993]	−0.727* [−0.912, −0.319]	0.858** [0.639, 0.975]	−0.883** [−0.950, −0.507]	1

** Indicates correlation is significant at the 0.01 level (2-tailed, P < 0.01).
* Indicates correlation is significant at the 0.05 level (2-tailed, $P < 0.05$). ($N = 213$).

Table 3
Summary of linear mixed-effects model predicting aesthetic appreciation for model comparison per level.

Model	Predictors	-2LL	AIC	BIC	Δχ2	df	p
M1	Unity, Variety	7361.561	7369.561	7392.216	–	–	–
M2	Unity, Variety, Typicality, Novelty	7059.372	7071.372	7105.355	302.189	2	< 0.001
M3	Unity, Variety, Typicality, Novelty, Connectedness, Autonomy	6538.510	6554.510	6599.821	520.862	2	< 0.001

Table 4
Summary of linear mixed-effects model predicting aesthetic appreciation for safety and accomplishment composites.

Predictor	B	SE	t	95% CI for B	p
Intercept	4.521	0.025	182.500	[4.473, 4.570]	< 0.001
Safety	1.255	0.033	37.665	[1.189, 1.320]	< 0.001
Accomplishment	0.611	0.034	17.983	[0.544, 0.677]	< 0.001

Note. B indicates Unstandardized Beta, SE indicates Standard Error for the Unstandardized Beta, CI indicates Confidence Interval.

appreciation than accomplishment factors. These findings support H2. Therefore, in the aesthetic appreciation of Chinese folding screens, unity, typicality, and connectedness from the "safety side" are preferred over variety, novelty, and autonomy from the "accomplishment side."

Through testing the full multilevel model that included all six predictors, this study evaluated which level (perceptual, cognitive, or social) in the UMA model had the strongest influence on aesthetic appreciation. The fixed-effects estimates (B values) listed in Table 5 indicate that all predictors at the perceptual, cognitive, and social levels positively influenced aesthetic appreciation of Chinese folding screen design. Comparing the β coefficients across levels, connectedness (B = 0.417, SE = 0.017, $t = 24.681$, 95% CI [0.384, 0.450], p < 0.001) showed the strongest influence, while variety (B = 0.089, SE = 0.019, $t = 4.724$, 95% CI [0.052, 0.127], p < 0.001) had the weakest impact.

Table 5
Summary of linear mixed-effects model predicting aesthetic appreciation for unity, variety, typicality, novelty, connectedness, and autonomy.

Predictor	B	SE	t	95% CI for B	p
Intercept	−0.580	0.159	−3.655	[−0.891, −0.269]	< 0.001
Unity	0.169	0.017	10.147	[0.137, 0.202]	< 0.001
Variety	0.089	0.019	4.724	[0.052, 0.127]	< 0.001
Typicality	0.220	0.017	12.680	[0.186, 0.254]	< 0.001
Novelty	0.118	0.017	6.765	[0.084, 0.152]	< 0.001
Connectedness	0.417	0.017	24.681	[0.384, 0.450]	< 0.001
Autonomy	0.167	0.018	9.099	[0.131, 0.204]	< 0.001

Note. B indicates Unstandardized Beta, SE indicates Standard Error for the Unstandardized Beta, CI indicates Confidence Interval.

Moreover, nested model comparisons conducted for hypothesis H1 (M2 vs. M1, M3 vs. M2) indicated that model fit significantly improved with the addition of cognitive-level predictors, and was further improved by the inclusion of social-level predictors. These results indicated that compared to perceptual and cognitive factors, social-level predictors contributed more to explaining aesthetic appreciation of Chinese folding screen designs. To be specific, the social level had the strongest effect, followed by the cognitive level, while the perceptual level had the weakest effect. H3 is supported.

Additionally, beyond main effects, interaction items were incorporated into the LMM to examine whether design features at different levels in the UMA model jointly influence aesthetic appreciation. Several significant interactions were observed. For example, there was a negative interaction between variety and typicality (B = −0.045, SE = 0.023, $t = -2.002$, $p < 0.05$, 95% CI [−0.089, −0.010]), indicating that typicality moderates the positive effect of variety on aesthetic appreciation. A positive interaction between connectedness and typicality was found (B = 0.069, SE = 0.022, $t = 3.157$, p < 0.05, 95% CI [0.026, 0.112]), suggesting that the effect of connectedness varies with typicality. In addition, higher-order interactions were detected, including a three-way interaction among novelty, variety, and autonomy (B = −0.047, SE = 0.018, $t = -2.631$, p < 0.05, 95% CI [−0.083, −0.012]) and a six-way interaction among unity, variety, typicality, novelty, connectedness, and autonomy (B = 0.026, SE = 0.010, $t = 2.526$, p < 0.05, 95% CI [0.006, 0.046]). These findings indicate that design features across different levels can interact to influence aesthetic appreciation.

Finally, to examine the robustness of the results, Generalized Estimating Equations (GEE) were conducted. As shown in Table 6, the predictive pattern of the six variables on aesthetic appreciation was consistent with the LMM results, with all findings statistically significant. Of all predictors, connectedness (B = 0.386, SE = 0.047, 95% CI [0.294, 0.477], p < 0.001) showed the strongest influence on aesthetic appreciation, while variety (B = 0.091, SE = 0.021, 95% CI [0.050, 0.132], p < 0.001) had the weakest effect. Importantly, the relative order of predictor contributions to aesthetic appreciation closely aligns with the LMM findings.

Table 6
Summary of generalized estimating equation analysis for variables predicting aesthetic appreciation.

Variable	B	SE B	95% CI for B	Wald z	P
Unity	0.183	0.024	[0.137, 0.230]	59.886	< 0.001
Variety	0.091	0.021	[0.050, 0.132]	18.774	< 0.001
Typicality	0.220	0.026	[0.168, 0.271]	69.106	< 0.001
Novelty	0.113	0.021	[0.072, 0.154]	29.682	< 0.001
Connectedness	0.386	0.047	[0.294, 0.477]	68.090	< 0.001
Autonomy	0.182	0.018	[0.146, 0.218]	100.038	< 0.001

Note. B indicates Unstandardized Beta, SE indicates Standard Error for the Unstandardized Beta, CI indicates Confidence Interval.

5. Discussion

This study empirically investigates how the combined effects of the perceptual, cognitive, and social levels contribute to the aesthetic appreciation of traditional cultural products. The results indicate that while each conceptual level uniquely contributes to aesthetic appreciation, the combined effects of perceptual, cognitive, and social levels provide a more meaningful explanation for the variation in aesthetic appreciation of Chinese folding screen designs compared to the effects of a single level. Specifically, all variables in the UMA model - unity, variety, typicality, novelty, connectedness, and autonomy - positively influence aesthetic appreciation. Connectedness had the strongest effect, followed by typicality, while variety had the weakest impact. Previous studies have primarily focused on one or two levels, lacking a more comprehensive explanation of complex aesthetic experiences. This study expands previous research by simultaneously investigating perceptual, cognitive, and social predictors within a multilevel framework, providing empirical support for the UMA model in the context of traditional cultural products.

At the perceptual level, compared to variety, unity has a more decisive effect on aesthetic appreciation, supporting previous findings (Loos et al., 2022; Tyan-Yu et al., 2017). This indicates that people prefer visually unified Chinese folding screens. However, results indicate that the effect of variety cannot be overlooked. Designs that are overly unified and lack variety are also not appreciated, which aligns with Boselie's (1996) perspective of "preserving unity while almost allowing for chaos" and with the "Unity-in-Variety" principle (Post et al., 2016; Van Geert & Wagemans, 2020).

At the cognitive level, the trade-off between typicality and novelty, which constitutes the MAYA aesthetic principle (Ceballos et al., 2021; Hekkert et al., 2003), shifts towards typicality. This result is consistent with previous findings that typicality plays a dominant role in aesthetic appreciation (Ceballos et al., 2020; Thai, 2019; Yahaya, 2017), contradicting the view that novelty is a more important predictor (Berlyne, 1971; Mridha et al., 2023; Suhaimi et al., 2023). In other words, it does not mean that novelty is unimportant, but rather that against culturally embedded stimuli, typicality may provide a stronger anchor for positive evaluation.

At the social level, data analysis reveals that Chinese folding screen designs characterized by both connectedness and autonomy are aesthetically appealing, which is consistent with Blijlevens and Hekkert's (2015, 2019) "Autonomous, yet Connected" social aesthetic principle. Nevertheless, connectedness demonstrated a stronger influence on aesthetic appreciation than autonomy in this study. Unlike findings from studies testing staplers and backpacks (Blijlevens & Hekkert, 2019), autonomy plays a more significant role in explaining aesthetic appreciation. This involves an evolutionary interpretation of aesthetic appreciation: evolutionary adaptations for safety and accomplishment guide the development of aesthetic appreciation for connectedness and autonomy. Staplers and backpacks, being less socially risky product categories, provide sufficient security, motivating people to seek accomplishment (autonomy). According to Blijlevens and Hekkert (2019) and Kaplan et al. (1974), although Chinese folding screens serve a functional purpose, culturally embedded objects, carry high social meaning and risk levels, in which aesthetic appreciation may rely more on increased awareness of connectedness.

It is noted that at the perceptual, cognitive, and social levels respectively, the dominant predictors - unity, typicality, and connectedness - are positioned on the safety side of the UMA framework. The LMM analysis results for the safety and accomplishment composites further confirm this finding. This can be interpreted by design emphasizing "accomplishment side" factors (variety, novelty, autonomy), potentially diverging from Chinese participants' traditional perceptions and aesthetic judgments of Chinese screens. Aesthetic experiences with traditional cultural products often closely relate to viewers' familiarity, cultural continuity, and social identity (Buschgens et al., 2024; Hekkert, 2014). Against this backdrop, "safety side" features may resonate more strongly as they reinforce existing cognitive schemas and social belonging. Therefore, "safety side" design features (unity, typicality, connectedness) play a more significant role than "accomplishment side" features (variety, novelty, autonomy) in explaining aesthetic appreciation of products with traditional cultural connotations. Designers can effectively use unity, typicality, and connectedness to enhance the aesthetic appeal of Chinese folding screens.

Unlike previous studies focusing on modernization and mass-market ordinary product categories, this study focuses on traditional cultural product categories to fill this gap. Throughout the study, from various perspectives, we compared the strength of influence across three levels. LMM and GEE analyses indicated that although each level contributes uniquely, the social level contributes more than the perceptual and cognitive levels in explaining aesthetic appreciation. Specifically, the social level has the strongest influence, followed by the cognitive level, and the weakest effect is from the perceptual level, which is consistent with expectations. However, the result differs significantly from the findings of Berghman and Hekkert (2017). They tested five sufficiently broad product categories - bicycles, sunglasses, espresso machines, desk lamps, and dining tables - and found that perceptual unity and variety had the strongest influence on aesthetic appreciation (Berghman & Hekkert, 2017). Based on aesthetic evolutionary needs and Blijlevens and Hekkert's (2019) integration of the social risk level of product categories into aesthetic appreciation, people place greater emphasis on the social effects of products for categories with significant social significance. Furthermore, previous research confirmed that aesthetic appreciation varies across individuals and cultures (Buschgens et al., 2024; Miller et al., 2025; Yeh & Peng, 2019). The stimuli in this study were highly culturally aligned with participants. Accordingly, the dominant role of the social level may stem not only from the cultural attributes of the artifacts themselves but also reflect a cultural matching effect. If the same stimuli were presented to non-Chinese cultural contexts, alternative patterns might emerge - for example, accomplishment-oriented factors such as novelty or variety might show stronger effects. Future cross-cultural comparative studies in aesthetics could further disentangle stimulus and participant effects.

Furthermore, the findings suggest that dynamic interactions among the perceptual, cognitive, and social levels and their factors constitute the multilevel effects of the UMA model in aesthetic appreciation. For instance, the positive interaction between typicality at the cognitive level and connectedness at the social level indicates they may mutually reinforce each other in shaping aesthetic responses. Conversely, the negative interactions between variety and typicality, as well as novelty and autonomy, suggest a trade-off relationship among these factors. Moreover, the interactions among novelty, variety, and autonomy, along with the interactions among all six predictors, further highlight that aesthetic appreciation of Chinese folding screens stems from the combined effects of multidimensional design features. Chinese folding screen designs that deviate from harmonious unity or emphasize novelty without recognizable cultural characteristics are less likely to be perceived as typical and may evoke weaker social identification, thereby reducing aesthetic appeal. This aligns closely with traditional Chinese

aesthetic concepts emphasizing “unity between heaven and humanity”, “balance between yin and yang”, and “harmonious unity”. Conversely, highly connected designs, while enhancing perceptions of typicality, may simultaneously reduce the contributions of variety and autonomy. Taken together, moderate innovation in Chinese folding screen design - while maintaining unity, typicality, and connectedness - is most likely to elicit positive aesthetic appreciation.

In summary, for Chinese folding screens, people appreciate the various appearances, while they are pleased by the fluent processing derived from a harmonious and unified aesthetic; people seek innovation, but they also experience aesthetic pleasure from the inheritance and familiarity of typical designs; people prefer unique designs but also seek a sense of security through the close connection that recognizes their social group identity. Given the cultural embeddedness of stimuli, the optimal explanation for aesthetic appreciation involves the combined effects of perceptual organization, cognitive expectations, and social meaning. Perceptual processing relates to formal visual organization, while cognitive processing, grounded in contextual information, triggers aesthetic experiences.

Aesthetic appreciation cannot be comprehensively understood through single-level or single-dimensional judgments but requires comprehensive evaluation across multiple dimensions and levels. We found that the category of stimulus is a critical influencing variable, providing valuable insights for empirical studies extended from the UMA model. For mass-market product categories, the perceptual or cognitive level generally plays a greater role in aesthetic appreciation. For traditional cultural products, the effect of the social level is more important. Although processing at the perceptual level primarily relies on the visual attributes of the design form itself, which may trigger relatively automatic and rapid aesthetic responses, the cognitive and social levels remain moderated by individual experience and cultural background. Such a focus on multilevel effects highlights the importance of exploring multiple factors and interdisciplinary approaches; uncovering the complex interactions among design attributes provides new insights; and investigating the functional yet culture-rooted product category deepens the existing research.

6. Limitations and future research

Although this study contributes theoretically and methodologically, the experimental process also revealed several limitations that suggest directions for future research. First, product visual design involves not only shape attributes but also critical elements such as color and material. In particular, patterns should also be considered in Chinese folding screen design. Additionally, while the UMA model is a multilevel framework, it may also extend across multiple sensory domains, such as tactile, which may influence aesthetic appreciation.

Another limitation concerns the absence of experimental manipulation of presentation time. Previous neuroscience studies suggest that the integration of sensory and contextual information can occur within a few hundred milliseconds after stimulus onset (Shimamura, 2012), indicating that perceptual, cognitive, and sociocultural information may already interact during early stages of aesthetic judgment. Nevertheless, explicitly manipulating viewing duration could provide a clearer understanding of how the relative contributions of perceptual, cognitive, and social factors evolve. Future research may therefore adopt time-controlled paradigms to examine how the multilevel mechanisms proposed by the UMA framework unfold across different stages of aesthetic processing.

In addition, although the stimulus set was limited to ten Chinese folding screens - close to previous empirical aesthetics studies and aligned with a theory-driven research design - this set may not represent the broad range of traditional cultural products. Future studies could incorporate additional cultural product categories, including those from non-Chinese contexts, to test the robustness and generalizability of the observed aesthetic mechanisms.

Finally, while recruiting culturally homogeneous participants ensured the typicality effect, this approach limits the cross-cultural generalizability of findings. Future studies could consider culturally diverse samples to examine how cultural matching or mismatching between objects and viewers moderates the relative importance of perceptual, cognitive, and social predictors.

7. Conclusion

Based on the unified model of aesthetics (UMA), the present study investigated the effects of the perceptual, cognitive, and social levels in predicting aesthetic appreciation of traditional cultural products. Results indicate that all three levels jointly influence aesthetic appreciation, with the social level explaining the largest variance. Considering the dual-factor theory of aesthetic appreciation, individuals place greater emphasis on safety factors than accomplishment factors. These findings underline the importance of considering multilevel aesthetic mechanisms when investigating product categories with cultural significance. Practically, the findings suggest that designers and stakeholders should prioritize unity, typicality, and relevance when exploring innovations in Chinese folding screen design to enhance aesthetic experiences. These insights also offer valuable references for design innovations in other traditional cultural products.

CRediT authorship contribution statement

Yanqin Gao: Writing – review & editing, Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Mohd Faiz bin Yahaya:** Writing – review & editing, Methodology, Data curation, Conceptualization. **Allan Whitfield:** Writing – review & editing, Methodology, Data curation, Conceptualization. **Deirdre Barron:** Writing – review & editing, Methodology, Data curation, Conceptualization.

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Data availability

Data will be made available on request.

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