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The Joint Effect of the Unified Model of Aesthetics and Categorical-Motivation Model on Aesthetic Preferences for Product Design: A Review

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Abstract

Aesthetics contribute to product usability and sales. Products with aesthetic appeal positively influence purchasing decisions, quality perceptions, and collections. In empirical aesthetics, many different theories and models of aesthetics have been proposed and empirically tested to explore human beings' unified aesthetic criteria and aesthetic psychological mechanisms. However, these findings suggest that aesthetic experience is multidimensional and that many conflicting viewpoints exist. Accordingly, the present review aims to explore the joint effect of two aesthetic models, the Unified Model of Aesthetics (UMA model) and the Categorical-Motivation model (CM model), on aesthetic preferences for product design in order to provide a more comprehensive understanding of the design aesthetics. Several keywords, including 'aesthetic preference,' 'aesthetic pleasure,' 'product design,' and 'product category,' were used to search literature in the online catalog. Sixty-five articles met the inclusion criteria through initial and full-text screening. The purpose is to understand how multiple dimensions of aesthetics and categories of products influence people's emotional responses. A review and critical analysis of previous ground-breaking research, theories, and principles of the levels of the UMA and CM models will be presented. Based on the critical insights, the strengths and limitations of each reviewed theory will be illustrated. Therefore, research gaps in the field are identified, and future research directions are proposed. It is hoped that design practitioners and researchers of empirical aesthetics will gain valuable insights from this review.

Keywords: Unified Model of Aesthetics, Categorical-Motivation Model, Aesthetic Pleasure, Product Design, Evolutionary Psychology.

Introduction

Why do we like what we like? In recent years, increasing academic interest in product aesthetics has found that the perceived aesthetics of a product contributes to product usability and sales (Landwehr et al., 2013; Berghman & Hekkert, 2017). Products with aesthetic appeal may positively influence purchasing decisions, quality perceptions, and collections (Hu et al., 2022). Furthermore, design aesthetics plays a crucial role in product design. In addition to considering technical functionality, stakeholders want to develop high-value, quality products by enhancing the aesthetic of product design (Shi et al., 2021).

Aesthetic psychology has flourished since Fechner pioneered 'experimental aesthetics' in 1876 and proposed 'aesthetic from below'. Starting with the essential elements and facts of aesthetics, investigating what elicits pleasure and how to elicit pleasure, Fechner aimed to lay the foundations for a well-developed aesthetic system and eventually to unify and illuminate the universal principles and art on beauty (Nadal & Ureña, 2021). Following him, many different theories and models of aesthetics have been proposed and empirically tested in exploring human beings' unified aesthetic criteria and aesthetic psychological mechanisms. In psychology, empirical aesthetics first focused on objects' structural and perceptual characteristics (Boselie & Leeuwenberg, 1985; Cupchik & Berlyne, 1979; Berghman & Hekkert, 2017). However, when considering the characteristics and meanings of objects (Leder et al., 2006; Whitfield, 1983), the scope of empirical aesthetics would be extended to aspects of cognitive nature (Berghman & Hekkert, 2017). Furthermore, social psychology and sociology research validated the importance of aesthetic preferences in terms of social meaning (Bourdieu, 1993). Additional studies have found that all these aspects concerning aesthetic responses are mediated by object category identity, which involves research in the field of taxonomy (Whitfield, 2000, 2009; Tyagi et al., 2013). In this light, these findings demonstrate that aesthetic experience is multidimensional and multidisciplinary. Although some individual studies have used some mechanisms to explain aesthetic preferences, it is still necessary to have a more general theoretical basis.

For this reason, Hekkert (2014), created the Unified Model of Aesthetics (UMA), which attempts to integrate factors that have been considered in isolation from existing ones and to reconcile aspects that influence aesthetic preferences in product design, aiming to establish a unified model of aesthetics for the design of artifacts (Hekkert, 2014). The model unifies existing theories of aesthetics across multiple disciplines and applies to multiple levels: perceptual, cognitive, and social. The UMA model provides a more comprehensive and foundational theoretical framework for product aesthetics (Berghman & Hekkert, 2017).

In empirical aesthetics, all the primary schools of psychology have contributed significantly. One of these, Daniel Berlyne, a behavioral psychologist, substantially influenced contemporary empirical aesthetics. He proposed the arousal theory of aesthetics based on motivational theory grounded in neuroscience (Berlyne, 1960). It was experimentally established that collative variables such as novelty, complexity, or asymmetry can be used to measure aesthetic preferences (Berlyne, 1970). In conflict with that, based on the principle of categorization proposed by cognitive psychologist Eleanor Rosch (1978), Whitfield and Slatter (1979) developed the theory of preference for prototypes, which suggested that typicality is a determinant of aesthetic preference (Whitfield & Slatter, 1979). This is because familiarity is

processed more fluently in the human brain. As a result, a positive aesthetic response is generated (Reber et al., 2004; Vogel et al., 2021). Moreover, the theory of aesthetic arousal and the theory of preference for prototypes cannot explain each other. It indicates that there are still contradictory aesthetic results at the cognitive level. To reconcile these controversial theories, Whitfield (2000) proposed the Categorical-Motivation model (CM model). The model accounted for these different positions using the relationship between emotion and taxonomy and emphasized the synthesis of aesthetic processing. The CM model claimed that all objects elicit an aesthetic evaluation and that the degree of preference depends on the processing of the stimulus categorization (Whitfield, 2009).

Given the complexity of the aesthetic experience, the CM model and the UMA model will be used as the basis of the present study to provide a more comprehensive understanding of the design aesthetics. Research gaps are identified by reviewing and critically analyzing previous groundbreaking research, theories, and principles of the levels of the UMA model and the CM model. Future research directions are suggested in the field. It is expected that design practitioners and researchers of empirical aesthetics will get valuable insights from this review.

Methodology

The literature search was performed in three stages. The keywords for searching came from related research fields. At first, to perform the preliminary literature screening, we searched for multiple keywords related to 'aesthetic preference,' 'aesthetic pleasure,' 'product design,' and 'product category' in databases (Google Scholar, Scopus, Web of Science, ScienceDirect, ProQuest), and cross-searching with the keywords 'aesthetic AND preference OR product AND category OR categorization AND motivation OR effect OR unity AND variety OR typicality AND novelty OR connectedness AND autonomy OR product AND aesthetic pleasure.' Considering the keywords and specific topics in the databases and limiting the search to the disciplines of psychology, arts, social sciences, and humanities, an initial 18,4000 articles were obtained from these databases. Moreover, periods of searching ranged from 1876 to the present. Screening of these search results was conducted by reading titles and abstracts. Exclusion criteria were used to screen eligible research at the reading of titles and abstracts stage. It was first determined which articles were relevant and screened for duplicates, which included research papers, review papers, or books published in English-language scientific journals. If the title or abstract did not indicate that it was about cognitive psychology and visual aesthetics, it was considered irrelevant to this study. Thereby, 186 articles were obtained and downloaded. Moving on to the next stage of full-text reading was then undertaken. Articles related to the product category or the perceived aspects of the product (unity, variety), cognitive aspects (typicality, novelty), and social aspects (connectedness, autonomy) were included in this study. In total, 65 articles met the selection criteria and were included in this review. All selected papers were summarized using EndNote software and Excel documents. Critical information was extracted from the articles, including author name, title, year, journal/publisher, methods and gaps, and future research. This study provides a comprehensive critical analysis and summary of previous literature to contribute to the investigation of the effect of the two models on aesthetic preferences for product design.

Literature Review

Aesthetic Preference

Due to mass production and consumption, people demand products with not only functional benefits (functionality and usability) but also emotional benefits (pleasure). 'Pleasure' is a 'specific response.' Human sensory stimuli, such as visual, tactile, and auditory, can bring about sensory pleasure. Perez Mata et al. showed that one of the 'pleasure' factors is visual pleasure, including 'aesthetic preference' for the shape of a product (Perez Mata et al., 2017). The visual characteristics of a product are crucial in determining product preference, as visual is the primary sense (Hekkert & Leder, 2008). Thus, this study focuses on the visual sensory aspect of human beings.

Hekkert et al. defined 'aesthetics' as the pleasure or displeasure from sensory-motor understanding. People make sense of the world around them through the sensory-motor system and the brain (Hekkert & Leder, 2008; Hekkert, 2014). Gu et al. pointed out that aesthetic preference is highly perceptual and refers to 'the result of an individual's perceptual processing of the visual features of an object in the course of a complete aesthetic experience' (Gu et al., 2018). Aesthetic experience is a high-level cognitive process. Cognition, imagination, and feelings will interact with each other in aesthetic experience (Wang, 2024). From the physiological perspective, neuroscience research confirms that visual stimuli with aesthetic elements have higher reward values in the brain than the ugly ones. Therefore, products with aesthetic visual elements trigger an instinctive positive response from consumers (He et al., 2022). The more aesthetically pleasing consumers perceive the product itself and the service design, the more likely the reward system in the brain is to be stimulated, which in turn improves the evaluation and preference for the product (Reimann et al., 2010). From a psychological perspective, consumers actively treat themselves well by pursuing beauty. Since materialistic consumption behaviors inherently have the significance of giving consumers personal identity symbols, consumption behaviors that are aesthetically pleasing doubly satisfy consumers' spiritual needs (Wang, 2024).

Aesthetic preference is an aesthetic judgment based on identifying a product's structure, order, or consistency (Desmet & Hekkert, 2007) and the integration of implicit memory associated with previous experiences (Leder & Nadal, 2014). Berlyne (1971) supported the influence of individual differences (e.g., tastes, sensibilities) on preferences for products. It follows that aesthetics will be perceived not only by the characteristics of the product design but also by the individual differences of the consumer (Ceballos et al., 2021). From aesthetic arousal, Berlyne (1971) argued that people prefer stimuli with moderate levels of complexity. Moreover, such preference assessment theories are widely used in aesthetics. However, based on Rosch's prototype theory of categorization, Whitfield and Slatter (1979) found that the degree to which a stimulus corresponds to a prototype of that object category accounts for liking, which means that prototypicality is an essential determinant of aesthetic preference. Thus, the existing research demonstrates the complexity of the aesthetic experience and that multiple factors and dimensions influence aesthetic preferences. In exploring topics related to the aesthetics of product design, a fundamental and comprehensive theoretical framework is needed that reconciles the various dimensions influencing aesthetic preferences, especially the critical but opposite variables among them.

Paul Hekkert (2014) created the Unified Model of Aesthetics (UMA), a framework that attempts to explain aesthetic appreciation for products comprehensively. It outlines research in many aesthetics-related fields, including cognitive psychology, social psychology, design, sociology, cognitive neuroscience, philosophy, and art, and simultaneously suggests many new avenues for future research (Hekkert, 2014).

Essential to the UMA modeling framework is the proposal that aesthetic preferences involve striking a balance between two evolutionary roots and complementary forms of pressure (Hekkert, 2014). One pressure drives us towards security and protection and inclines towards choices that improve perceived understanding and efficiently process and unite group members. The other pressure involves the desire to learn and accomplish, which leads to a preference for variety, novelty, and uniqueness (Hekkert, 2014). Tensions and trade-offs between impulses occur in each across several sensory modalities (Hekkert, 2014). Consistent with evolutionary claims, UMA's structured aesthetic framework indicates the claim of two opposing forces in humans that influence aesthetic preferences at all levels of aesthetic processing: perceptual, cognitive, and social. The perceptual level focuses on elements, including unity and variety. The cognitive level focuses on typicality and novelty. In addition, the social level involves connectedness and autonomy. Aesthetic preferences for products are determined by a set of conflicting needs for safety and accomplishment in humans (Berghman & Hekkert, 2017). Moreover, many studies have shown that aesthetic pleasure comes from the balance of two opposing forces at either end of the UMA model (Ceballos et al., 2021; Thurgood et al., 2014; Logkizidou, 2021; Blijlevens & Hekkert, 2019; Yahaya, 2017). The Unified Model of Aesthetics is shown in Figure 1.

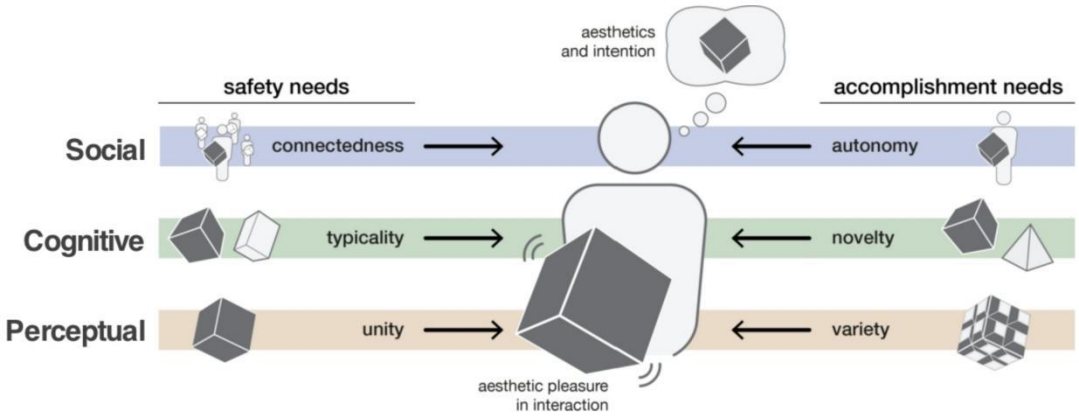

Figure 1. Unified Model of Aesthetics (UMA model)

Unity and Variety at the Perceptual Level

The attributes of symmetry, contrast, unity, complexity, and variety are the conventional determinants of aesthetic pleasure (Post et al., 2017), influencing aesthetic preferences for product design. At the perceptual level of the UMA model, many studies have validated and supported the view that people prefer stimuli that satisfy the need for unity and variety. That is, they prefer 'unity-in-variety'（for example, Berghman & Hekkert, 2017; Loos, 2022; Post et al., 2017; Post et al., 2023). Humans positively avoid boredom by seeking variety due to our innate tendency to explore and acquire new information (Berlyne, 1966; Post et al., 2016). However, too much variety can confuse our senses, causing confusion and a lack of understanding. Unity is the perception of a whole of order and consistency between

attributes and elements (Veryzer & Hutchinson, 1998; Post et al., 2016). The ability to see unity in an inherently chaos world can assist humans in making sense of their surroundings. Since unity and variety are essentially partial opposites, the highest aesthetic appreciation of a product is achieved when unity and variety are simultaneously maximized and balanced (Post et al., 2023). Indeed, the principle of 'unity-in-variety' was known in ancient Greek times and has been influential in aesthetics ever since (Berlyne & Boudewijns, 1971; Fechner, 1876). The principle has often been used to account for artistic aesthetics (Cupchik et al., 1996), architecture (Nasar, 1994), and musicology (Cohen, 1990) and has subsequently been extended to human-computer interaction (Post et al., 2015; Post et al., 2017). However, it was shown to be equally valid in the aesthetic appreciation of product design for products such as lamps, espresso machines, and motorbikes (Post et al., 2016). However, Post et al. posited that ' in some conditions, one variable will always be more important than the other in our aesthetic response' (Post et al., 2016). After all, safety and risk conditions will drive preferences for unity or variety of products, respectively. To date, it has not yet been clearly demonstrated which is the dominant factor and which has a greater effect on the aesthetic response to unity and variety in product design.

Typicality and Novelty at the Cognitive Level

The role of typicality and novelty at the cognitive level in predicting aesthetic preferences has been tested in the last decades by many empirical studies using different designed products such as furniture (Whitfield & Slatter, 1979; Whitfield, 1983), lamps (Blijlevens et al., 2014), cars (Mayer & Landwehr, 2018), smartwatches (Lee, 2021), toothbrushes (Yahaya, 2017), industrial boilers (Suhaimi et al., 2023), and so on. It can be known that the effectiveness of typicality in predicting aesthetic preferences is clearly identified: high typicality equals high preference (Suhaimi, 2021; Blijlevens et al., 2012; Mayer & Landwehr, 2018). Also, the positive role of novelty in predicting designed product preferences can be found in research (Seifert & Chattaraman, 2020). Obviously, novelty contributes to preference and interacts with typicality to jointly determine preference. As an explanation, it is argued that typicality and novelty satisfy the fundamental evolutionary need for security and exploration that still drives behavior today. In contrast to research on unity and variety at the perceptual level, the joint influence (Thurgood et al., 2014) and interaction (Yahaya, 2017; Suhaimi, 2021) around the contradictory variables, typicality and novelty, on aesthetic preferences for designed products has been tested in studies of aesthetic responses to different stimuli. However, the question left is that there are still contradictory results in testing the relationship between typicality, novelty, and preference. It may indicate that other moderating factors, such as unity or variety of products, connectedness, or autonomy at the social level, influence the role of typicality and novelty in aesthetic appreciation. That is a clear gap in the current field of research.

Connectedness and Autonomy at the Social Level

Person-to-person and person-to-product interactions, at the social level, enable persons to belong to a group through product design (connectedness) but also help them to distinguish themselves as autonomous individuals (autonomy) (Blijlevens & Hekkert, 2015). Accordingly, at the social level, the aesthetic experience of objects can be determined by the degree of preference for connectedness and autonomy they represent (Berghman & Hekkert, 2017). In contrast to the literature representing unity and variety at the perceptual level and typicality

and novelty at the cognitive level, research on connectedness and autonomy at the social level has been neglected in design aesthetics. However, to date, the only research supported the search for a balance between connectedness and autonomy regarding aesthetic preferences in designing products (Bilijlevens & Hekkert, 2015; Bilijlevens & Hekkert, 2019). Bilijlevens and Hekkert used products, sunglasses, staplers, backpacks, etc., to conduct three studies and found that underlying evolutionary needs for safety and accomplishment promoted an aesthetic appreciation of autonomy and connectedness, which had the same effect as the other two levels. Nevertheless, it also raised the question of the inadequacy of existing research. It can be seen that more empirical examples are needed to investigate and validate how the two variables of the social level, autonomy and connectedness, operate and how they predict the degree of preference for a designed product, which highlights another gap in the current field of research.

From the above studies, it is clear that the models developed by researchers investigating aesthetic preferences for product design aim to explain why and how specific product dimensions (e.g., typicality, unity, connectedness) have an impact on aesthetic preferences, such as Berlyne's arousal model (Berlyne, 1960), Loewy's 'Most Advanced, Yet Acceptable' design principle (Loewy, 2002). However, these can only explain the relationship between one dimension (typicality, the perceptual dimension) and aesthetic preference while ignoring the opposing forces of the opposite dimensions at each UMA level and the interactions between the dimensions. This narrow perspective has led to a limited understanding of these three levels and their joint influence on aesthetic preferences within the framework of UMA. Consequently, a crucial research gap is that the joint influence of all three levels of the UMA model (perceptual, cognitive, and social) on aesthetic preferences needs to be systematically explored.

Categorical-Motivation Model

The Categorical-Motivation model (CM model) (Whitfield, 2000) was proposed to reconcile the two main opposing theories in psychology at the time, the collative-motivation model (Berlyne, 1960) and the preference-for-prototypes model (Whitfield & Slatter, 1979). In the early 1980s, Whitfield compared the two opposing models' power of prediction for many furniture samples in three experiments. The results validated the categorizability of stimuli as an essential variable in aesthetic research. Meanwhile, in an attempt to reconcile these different positions, he suggested that stimulus categorizability (prototypicality) and stimulus-generating arousal potential (novelty) may jointly influence affective decisions (Whitfield, 1983).

The CM model was developed and finally established in two stages. In the first stage, Whitfield (2000) provided a detailed description of the model. He illustrated the relationship between categorization and aesthetic response by drawing on two components from Tversky's (1977) concept of feature salience: intensive salience and diagnostic salience (Tversky, 1977). Intensive salience is the feature that attracts attention through arousal potential, while diagnostic salience is the categorical meaning of the feature (Whitfield, 2000). The significance of the division is that a link is made between intensive salience and arousal (novelty) and between diagnostic salience and prototype (typicality) (Whitfield, 2000). In this

way, it reconciles the two opposing positions represented by the arousal and categorization models and overcomes some limitations of previous theories.

In the second stage, Whitfield (2005), proposed a bipolar categorization process for aesthetic arousal, with emotion as the essential element, to introduce a processing strategy to guide its operation. Given that the Categorical-Motivation model originated in categorization and that aesthetics involves bridging categories at the sensory perception dimension, the CM model is oppositely bipolar (Lindgaard & Whitfield, 2004). Lindgaard and Whitfield placed aesthetics in an evolutionary context and explained this bipolar categorical processing with existing psychological theories. One extreme is closed categories or fixed somatic markers. Such categories do not require further representation: for whatever reason, this does not have an assimilative function for the individual (Lindgaard & Whitfield, 2004). Here, approaching the prototype generates pleasure; the closer the prototype, the higher the pleasure. These prototypes or somatic markers will provide essential reference points for rapid navigation of the system (Lindgaard & Whitfield, 2004). This relatively simple and familiar process provides a sense of security. For categories or somatic markers that are still open and ill-formed, pleasure accompanies the processing of new stimuli, leading to further clarification of the category and consequently forming prototypes (Lindgaard & Whitfield, 2004). It requires effort in pursuing new things, referencing stored knowledge of existing 'facts,' and eventually becoming 'prototypical' things. In other words, the open category end of the CM model will eventually turn to the closed category end. In an evolutionary sense, like the UMA model, human beings process opposites to achieve security.

Product Category

Rosch's categorization theories proposed in 1978 have been widely applied by many studies to describe the relationship between stimulus typicality, prototypicality, and aesthetic preference. However, Tyagi et al.'s study showed that Rosch's categorization theories also play a significant role in explaining the relationship between novelty and preference, which is considered to be the basis for explaining novelty (Tyagi et al., 2013). The CM model's bipolar categorization of products into open and closed categories is based on Rosch's taxonomy.

Closed categories cannot be further expressed and can be explained by categorization. For example, in the 'culture' domain, Renaissance paintings would fall into the closed category for a Western-educated audience. The preference-for-prototypes model suggests that we prefer things familiar to us, and the more an object fits into that category, the more it is preferred (Whitfield, 2005). The closed category explains the source of pleasure in terms of the speed of categorization of the stimulus (Whitfield, 2009). The other end is the open category, a poor categorzability category. For example, such designed products as mobile phones and computer printers are not already well-formed categories. For the open category, novel stimuli are preferred (Whitfield, 2009), and Berlyne's exploratory behavior and the spirit of positive arousal of potential account for the pleasure of the aesthetic experience. In effect, a 'new' thing has never been seen or experienced before but has enough similarities to what has already been experienced to serve as a reference for prototyping. Coughlan and Mashman (1999) verified that novel stimuli eventually turn into un-novel stimuli through experiments on car design.

However, these studies and explanations are derived from cognitive level considerations. The CM model proposed by Whitfield is a synthesis of three functions of aesthetic response: arousal-related processing (perceptual level), categorical processing (cognitive level), and social meaning (social level) (Whitfield, 2000). Therefore, the synthesis approach implicit in the CM model can hardly explain the multidimensionality and complexity of aesthetic phenomena only at the cognitive level. Moreover, previous studies have shown that it still needs to be validated using a more comprehensive range of products. Figure 2 shows previous studies' research theories and gaps regarding the open and closed categories.

Figure 2. Previous studies' research theories and gaps regarding the open and closed categories.

Aesthetic Preferences for Product Design

People are increasingly concerned about the study of aesthetic preferences for product design. On the one hand, the development of enterprises requires products to be constantly upgraded in order to gain the attention and recognition of the market, and product design is an indispensable driving force. On the other hand, some researchers have recognized that product aesthetics have a close relationship with consumers and that products with design aesthetics are more likely to gain consumers' attention and affection and ultimately stand out in the market (Toufani et al., 2017; Althuizen, 2021; Logkizidou, 2021). Post et al. investigated how 'unity' and 'variety' predicted aesthetic appreciation for various product designs in three studies using lamps, espresso machines, motorbikes, car interiors, tables, and USB sticks (Post et al., 2016). Tyan et al. used a chair as a visual stimulus to suggest that unified design guidelines for enhancing product aesthetics can be used to design products with a pleasing sensation (Tyan et al., 2017). Logkizidou focused on the importance of the principle 'unity-in-variety' for the merchandise's visual display aesthetics (Logkizidou, 2021). Tyagi tested the effect of individual elements of objects on aesthetic preferences using chairs and chests of drawers (Tyagi, 2017). Yahaya tested visual and tactile tolerance of typicality and novelty using toothbrushes and mice (Yahaya, 2017). Suhaimi et al. explored the extent to which typicality and novelty predicted aesthetic preference by choosing industrial boilers as stimuli in order to test the applicability of aesthetic processing to less conspicuous objects (Suhaimi et al., 2023). Using Chinese operas as stimuli, Li et al. focused on the seemingly opposing concepts of typicality and novelty with a mixed-method approach combining labeled and field research (Li et al., 2024). Sasaki et al. conducted cognitive experiments on car shapes generated by a particle swarm optimization method, discussing the application of complexity and novelty to aesthetic preferences (Sasaki et al., 2023).

Additionally, studies have shown that the higher the social status of a product, the more attention or interest it will generate. It is essential for product designs that appear simple as they may not generate enough excitement or interest (Althuizen, 2021). Hashmi et al. used electronic products to explore the impact of product design on customer engagement through the fulfillment of self-determined needs (autonomy, connectedness, and competence) (Hashmi et al., 2021). Blijlevens and Hekkert focused on the relationship between connectedness and autonomy and the aesthetic appreciation of product design from a social level, using products such as sunglasses, bicycles, backpacks, trainers, staplers, etc., to demonstrate how conditions of safety and risk can moderate the social aesthetic principle of 'autonomy but connectedness' (Blijlevens & Hekkert, 2019).

Previous studies have focussed on a wide range of product designs in terms of various aesthetic dimensions, particularly the cognitive level. In contrast, due to the fact that little attention has been paid to the social level and to the ancient principle of 'unity-in-variety,' only a few products have been tested at these levels. The result provides a foundation for future research but also suggests directions.

Theoretical Framework

The UMA and CM models are used to predict aesthetic preferences for product design. The UMA focuses on the various aspects of aesthetic responses that influence product design: perceptual, cognitive, and social. Since the different levels of UMA involve two variables that appear to be opposites: unity and variety of the perceptual level, typicality and novelty of the cognitive level, and connectedness and autonomy of the social level, Hekkert et al. explained the seemingly contradictory dimensions based on the evolutionary theory (Hekkert, 2014; Berghman & Hekkert, 2017). Moreover, the CM model assumes that all objects elicit aesthetic evaluations and that the degree of preference depends on the processing of the stimuli categorization (Whitfield, 2009). Product design for the closed category is concerned with prototypicality (safety), whereas product design for the open category seeks novelty (risk). Nevertheless, products in the open category have enough redundancy to allow for categorization and, thus, further prototyping. As such, the product category is a mediating variable that moderates the contradictory or inconsistent theories at all levels of aesthetics. The interaction of the UMA and CM models of aesthetic preferences for product design is constituted. Figure 3 shows the theoretical framework of this study.

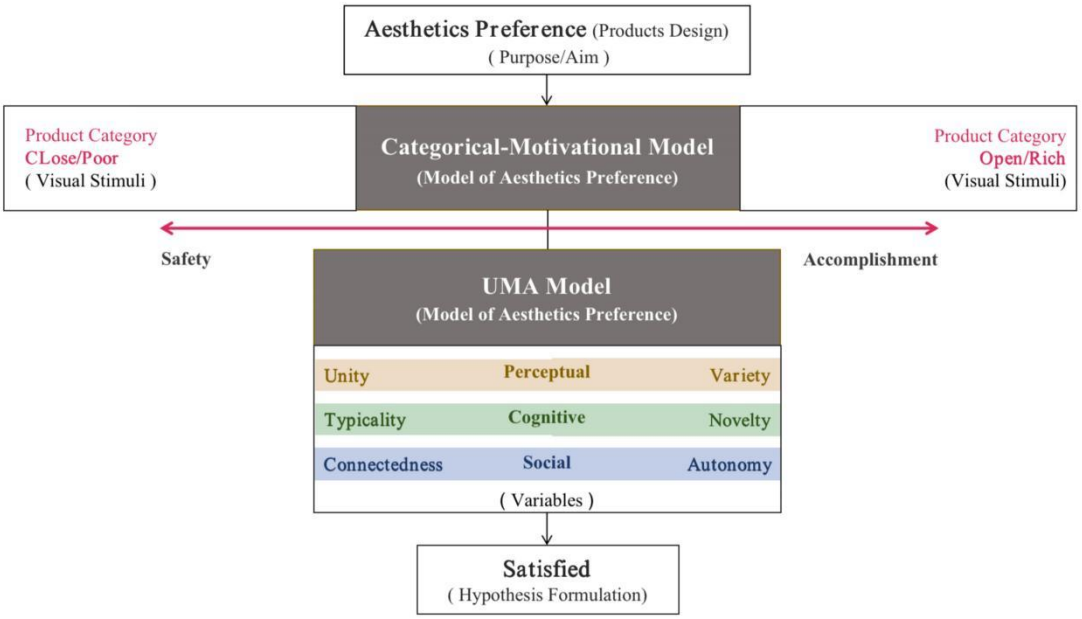

Figure 3. Theoretical framework.

Discussion

The fundamental theoretical perspective of the Unified Model of Aesthetics (UMA) is consistent with Darwin's evolutionary claims. Aesthetic attraction to things we perceive is based on two concurrent evolutionary pressures. On the one hand, security is a basic human need, and humans survive through access to familiar things and environments (typicality, unity, and connectedness). On the other hand, humans are better adapted for survival and accomplishment by seeking the new and unfamiliar (novelty, diversity, and autonomy) (Yahaya, 2017). Accordingly, the need for accomplishment has evolved to balance the need for security. The UMA model accommodates three levels, focusing on the balance between these two opposing demands and how to achieve this balance (Yahaya, 2017).

In empirical aesthetics, Whitfield (2000), proposed a CM model that reconciled the opposing positions of the two leading theories in psychology at the time. In applying the Categorical-Motivation model, at the cognitive level, familiarity makes all perceptual and cognitive processing of objects more accessible and more fluent (Reber et al., 2004), resulting in a more favorable aesthetic response to objects. Liking and familiarity obviously have an evolutionary advantage because they are perceived to be safer. To be noted, the application of the CM model needs to consider the role of the social value of stimuli in determining aesthetic preferences (Whitfield, 2009). In this way, people can fulfill their evolutionary safety needs by designing products that connect them to the group. Figure 4 shows that both UMA and CM models are concerned with finding out preference safety.

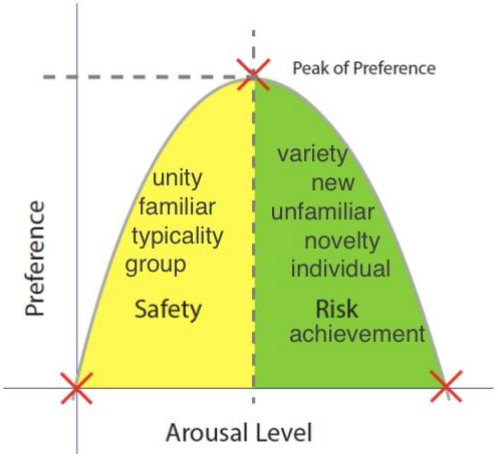

Figure 4. Both UMA and CM models are concerned with finding out preference-safety.

Both aesthetic models emphasize the multidimensionality of aesthetics and explain the diversity of theories and contradictory findings presented from an evolutionary viewpoint. The former focuses on integrating existing factors that have been considered in isolation, while the latter focuses on the moderation of the category identity of stimuli. The combination of both applied to explaining aesthetic preferences in product design is worth further exploration, especially as it requires experimental validation using a more comprehensive range of categories.

Conclusion

Many researchers in empirical aesthetics have noted the complexity and multiplicity of aesthetics. The present study provides further insights into the interaction between multiple dimensions of aesthetics and categories of products on affective responses by reviewing and critically analyzing research related to two models, the Unified Model of Aesthetics and the Categorical-Motivation model, for predicting aesthetic preferences. The UMA and CM models attempt to establish a comprehensive, unifying conceptual framework of aesthetics and have been subjected to extensive empirical research. At the same time, research gaps are highlighted within the field. First, so far, no research has systematically explored all three levels of aesthetic preferences in the UMA model. That is because research has shown that aesthetics is not only influenced by the two opposite dimensions but also interacts at different perceptual levels. The second gap relates to the tolerance of the 'closed/open' category from the CM model for the six variables from the three levels of the UMA model. The perceptual level of unity and variety and the social level of autonomy and connectedness have not been tested. Last but not least, research on aesthetic preferences in product design still needs to be validated by more product categories. Not only universal and market-representative product design aesthetics need to be brought into focus, but also those uncommon products and those with national cultural characteristics. After all, every country attaches great importance to the inheritance and innovation regarding their traditional culture. That is very important. It is expected that design practitioners and researchers of empirical aesthetics will get valuable insights from the present study.

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