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RESEARCH ARTICLE

Exploring the psychological mechanism of how the multidimensional features of computer products affect consumer satisfaction: An extension of the unified model of aesthetics (UMA)

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ABSTRACT

This study examines the psychological mechanisms underlying consumer responses to computer product appearances by employing the Unified Model of Aesthetics (UMA) as an integrative framework. UMA proposes that aesthetic evaluation arises from the reconciliation of evolutionary needs for safety and accomplishment across perceptual, cognitive, and social levels. Building on this model, the study incorporates key attributes—unity, variety, proximity, closure, symmetry, continuity, typicality, novelty, performance, security, connectedness, and autonomy—to analyze their contributions to consumer satisfaction. Data were collected from 211 computer users in China and analyzed using confirmatory factor analysis and structural equation modeling. The results show that perceptual organization cues, including unity, variety, and Gestalt-based principles, enhance satisfaction by supporting coherent and fluent visual processing. Cognitive attributes such as typicality and novelty jointly reinforce the balance between familiarity and advancement, while performance and security strengthen safety-oriented evaluations. Social attributes, including connectedness and autonomy, significantly influence satisfaction by addressing needs for group affiliation and individual expression. Overall, the findings validate UMA as a useful framework for explaining aesthetic responses to high-technology products and highlight the importance of integrating perceptual, cognitive, and social dimensions in product design. These insights provide actionable implications for firms seeking to improve user experience through strategically crafted visual and symbolic features.

Keywords: perceptual organisation; cognitive evaluation; social meaning; visual coherence; aesthetic judgement

1. Introduction

With the increasing demand for personal mobile computing, the market for computer products has shown a renewed growth trend in recent years. Global personal computer (PC) shipments increased by 1.5% year-over-year in the first quarter of 2024, reaching 59.8 million units and ending a two-year decline[1,2]. Gartner reported a similar rise in the second quarter, with shipments totaling 60.6 million units—an increase

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of 1.9% from 2023[3]. Counterpoint Research further predicts that shipments will reach 65.3 million units in the third quarter of 2024, growing by 1% year-over-year[4]. Despite this recovery, PC manufacturers continue to face major challenges in demand forecasting, as rapid technological change and short product life cycles make consumer needs increasingly volatile[5]. As Jung and Lim (2016) note, adaptive forecasting systems are essential for aligning production with dynamic market conditions, thereby maintaining both competitiveness and customer satisfaction[6]. This context highlights the importance of identifying the factors that influence consumer decisions and long-term loyalty toward computer products.

To address market uncertainty and ensure sustainable profitability, scholars have examined consumer satisfaction and loyalty from multiple perspectives. These include transitions to value-based sales models[7], the role of aesthetic experience in shaping user evaluation[8], algorithmic approaches to predicting sales fluctuations[9], and organizational strategies for managing market volatility[10]. Although these studies contribute valuable insights into operational and strategic decision-making, they often overlook a critical component of consumer choice: the psychological and aesthetic mechanisms that shape how users evaluate computer products, particularly their visual appearance, which strongly influences early-stage decision-making.

Recent research emphasizes that customer satisfaction plays a mediating role between service quality and customer loyalty[11,12]. Market orientation[13] and marketing mix strategies[14] also affect satisfaction, but consumers differ greatly in their psychological responses and personal characteristics, suggesting that satisfaction is shaped not only by functional attributes but also by deeper perceptual and emotional processes[15–19]. However, existing studies on computer consumer satisfaction have paid limited attention to these psychological mechanisms. This gap underscores the need for a comprehensive model that explains how aesthetic and cognitive factors jointly influence consumer evaluations. To address this need, the present study integrates the Unified Model of Aesthetics (UMA) with perspectives from Darwinism, evolutionary psychology, and Gestalt theory to examine the perceptual, cognitive, and social attributes that influence consumer satisfaction with computer products. UMA provides a coherent framework for understanding how individuals experience product aesthetics by combining evolutionary motivations for safety and accomplishment with principles of unity-in-variety, typicality–novelty balance, and autonomous–yet–connected social meaning[8]. Darwinism and evolutionary psychology explain innate human preferences for familiarity, novelty, performance, security, connectedness, and autonomy[19–21]. Gestalt theory, focusing on principles like unity, variety, proximity, closure， symmetry, and continuity, provides a framework for understanding how consumers perceive and organize visual information, affecting their aesthetic appreciation and satisfaction[16–18,22].

By examining how these factors jointly influence satisfaction, this study aims to advance understanding of computer consumer behavior and provide practical insights for improving product design, marketing strategies, and user experience. Accordingly, this research adopts UMA as the primary theoretical approach and applies a quantitative method to test the relationships among perceptual, cognitive, and social aesthetic attributes and consumer satisfaction. Importantly, while UMA has been widely applied to general product design and aesthetic evaluation, its empirical application to contemporary, technology-oriented products—where functional symbolism and social identity are particularly salient—remains limited; this study addresses this gap by extending UMA to the context of computer products.

2. Literature review

2.1. Darwinian perspective in product

The Darwinian perspective, rooted in the principles of evolution articulated by Charles Darwin, emphasizes the processes of variation, selection, and retention as fundamental mechanisms driving evolution across various domains, including biology, psychology, and organizational theory[23]. Darwinian principles suggest that organizations that effectively adapt to consumer preferences are more likely to thrive. Eyuboglu and Buja (2007) discuss quasi-Darwinian selection in marketing relationships, highlighting that businesses can enhance the longevity of their customer relationships by adapting their practices based on customer feedback and preferences, which directly correlates with customer satisfaction[24]. This perspective suggests that customer satisfaction is not merely the result of transactional interactions but is deeply rooted in psychological and social factors that have evolved over time. For instance, the research by Milner and Furnham (2017) found that customer satisfaction is crucial for long-term business success, as it is directly related to profitability and customer retention rates[25]. Teo's study (2024) identified a positive correlation between psychological traits and customer satisfaction, emphasizing that personality and social belonging affects how customers perceive and evaluate their experiences[26].

Furthermore, the concept of generalized Darwinism suggests that evolutionary principles can be applied beyond biological contexts to understand organizational and product development. Hodgson (2013) emphasizes the importance of selection and adaptation in organizational evolution, which also applies to the iterative processes involved in product design[27]. This view suggests that products evolve through a process of trial and error, with only the most successful designs surviving in the market, akin to natural selection in biological systems. The entrepreneurial landscape also reflects Darwinian principles, as seen in the typology of founders described by Fauchart and Gruber. They categorize entrepreneurs into three types, with Darwinian entrepreneurs focusing on creating products that meet established customer needs, thus ensuring commercial viability[28]. This approach highlights the importance of understanding market dynamics and consumer behavior from an evolutionary perspective, as successful products often result from a deep understanding of existing needs and the ability to adapt to changing preferences.

To further validate the relationship between customer satisfaction and the Darwinian perspective, we examine the connection between product appearance and aesthetic preference. In the context of product design, aesthetic principles derived from adaptation, variation, and selection. For example, Blijlevens and Hekkert argue that product designs that balance opposing design dimensions satisfy the basic evolutionary needs for safety and accomplishment, thus enhancing aesthetic appreciation[21]. Aesthetic responses to products stem from two fundamental impulses:one is the need for safety, represented by typicality; the other is the need for risk, defined by novelty[8,29]. This implies that successful product design is not only about functionality but also aligns with the idea of meeting deeper psychological needs, which can be seen as an adaptive strategy in competitive markets. Furthermore, unity and variety also positively influence customer satisfaction. This is consistent with the perspective that environmental safety affects the evaluation of unity and variety. For example, the study by Hekkert et al. (2016) demonstrates that while unity and variety are negatively correlated, they both contribute to customer satisfaction when controlled for each other[30]. Based on these findings, the following hypothesis is proposed:

H1. From a Darwinian perspective, typicality and novelty has a positive impact on customer satisfaction with computer products.

H2. From a Darwinian perspective, unity and variety has a positive impact on customer satisfaction with computer products.

H3. From a Darwinian perspective, connectedness and autonomy has a positive impact on customer satisfaction with computer products.

2.2. Gestalt Principles in product

The Gestalt principles, originating from Gestalt psychology, focus on how humans perceive visual elements as organized wholes rather than isolated parts. This psychological framework asserts that the brain integrates sensory stimuli into coherent forms, emphasizing that "the whole is greater than the sum of its parts"[31]. The Gestalt principles have been shown to be useful in improving customer satisfaction. For example, Ali and Peebles (2012) studied methods of promoting grouping of graphical elements using Gestalt principles and found that creating intuitive interfaces and visual displays can enhance customer satisfaction[32]. Similarly, Yalcinkaya and Singh (2019) explored how Gestalt principles improve data visualization and user experience, demonstrating their applicability in enhancing the usability of complex information systems[33].

The fundamental principles of Gestalt theory include proximity, similarity, closure, good continuity, symmetry, and figure-ground separation[34,35]. In practical applications, these principles are used in various fields. For instance, Pandey discusses how aesthetics in product design can be influenced by Gestalt principles, emphasizing that proximity can lead to improved functionality and attractiveness in layouts[36]. Gestalt principles are also closely linked to user experience. Closure, another key principle, refers to the mind's tendency to perceive incomplete shapes as complete. This principle can be effectively utilized in design to create visual coherence and facilitate quicker recognition of forms. Gerhardstein et al. (2012) provide insights into how closure mechanisms operate within the visual system, indicating that closure can enhance perceptual facilitation in design contexts[37].

Moreover, in the context of artificial intelligence and computer vision, researchers have utilized Gestalt principles to improve object detection and image segmentation algorithms, showing the relevance of these principles beyond traditional psychology[38,39]. Valencia-Romero and Lugo (2017) proposed a method that allows designers to conduct discrete choice experiments to elicit product aesthetics based on Gestalt principles, such as symmetry, parallelism, and continuity. This modeling framework emphasizes the importance of order and complexity in aesthetic evaluation, encapsulated in the equation $M = O/C$, where M represents aesthetics, O represents order, and C represents complexity[16]. This model aligns with the Unified Model of Aesthetic, which posits that aesthetic experience arises from a balance between a sense of security and a sense of accomplishment, embodied in the principle of unity in diversity[15,22]. Hu et al. (2024) validated the model using computers as stimuli and found that unity and variety can be used as variables to measure product perceptions, which have a positive impact on satisfaction with computer products[40]. Based on these findings, the following hypothesis is proposed:

H4. From a Gestalt Principles, proximity and closure has a positive impact on customer satisfaction with computer products.

H5. From a Gestalt Principles, unity and variety has a positive impact on customer satisfaction with computer products.

H6. From a Gestalt Principles, symmetry and continuity has a positive impact on customer satisfaction with computer products.

2.3. Evolutionary psychology in computer

Previous research has explored the relationship between evolutionary psychology and customer satisfaction, suggesting that consumer psychology is not unique to modern society but rather a psychological

mechanism retained through human adaptive evolution. These mechanisms helped our ancestors cope with survival and reproductive pressures and have been passed down in genetic form to this day[41]. Understanding these psychological mechanisms can aid in introducing deeper explanatory models in consumer behavior and psychology research.

Some previous studies have examined how psychological factors impact customer satisfaction. Teo (2024) found that psychological factors, such as customer expectations and perceptions, are crucial in influencing their satisfaction with products and services [26]. The concept of psychological empowerment, closely related to evolutionary psychology, has been shown to moderate the relationship between service fairness and customer satisfaction. Similarly, Saad and Gill argue that evolutionary psychology can provide insights into consumer behavior, indicating that innate psychological mechanisms influence consumers' evaluations of products and services[42]. This aligns with the findings of Pandey et al., who assert that customer satisfaction arises from an individual's comparison of perceived product performance with expectations, which are often influenced by psychological tendencies[19]. Qi's research (2024) further explains customer expectations, stating that these expectations are associated with risk-aversion motivations, aligning with the evolutionary principle that individuals prioritize safety and stability in decision-making[43].

In addition to the safety and stability expectations of products, group identity on a social level also influences customer satisfaction. For example, Mather and McReynolds' research highlights the importance of product satisfaction from the perspectives of group identity and evolutionary history. They found that when we express affection for certain products, they become associated with specific groups, symbolizing group identity, which can enhance our aesthetic appreciation for them. Being part of a group can increase survival rates by improving access to mates and shared resources, offering a sense of security that individuals may not achieve alone[20]. Hekkert et al. (2019) validated the idea that two social needs—connectedness and autonomy—parallel evolutionary drives for safety and achievement[21]. Connectedness reflects the intrinsic social need to form relationships and experience intimacy[44,45]. Conversely, autonomy reflects a need to see oneself as unique and maintain freedom and control[44,46]. Individuals who successfully stand out gain status, influence, resources, and better health[47,48]. In addition, Qi et al. (2024) linked typicality, novelty, and evolutionary psychology. The study revealed that typicality is associated with risk-avoidance motives, aligning with the evolutionary principle that prioritizes safety and stability in decision-making. Novelty, on the other hand, stems from the human drive for exploration and achievement, emphasizing uniqueness and distinction[43]. Based on the discussion so far, the following hypothesis is proposed:

H7. From an Evolutionary Psychology, typicality and novelty has a positive impact on customer satisfaction with computer products.

H8. From an Evolutionary Psychology, performance and security has a positive impact on customer satisfaction with computer products.

H9. From an Evolutionary Psychology, connectedness and autonomy has a positive impact on customer satisfaction with computer products.

2.4. Customer satisfaction with computer product appearance

The relationship between customer satisfaction and computer product appearance has been well-established. In this context, customer satisfaction refers to the overall positive evaluation of the product provided[49]. Computer product appearance refers to the external form and visual characteristics displayed by computers and related products in the design and manufacturing process[50], including shape, color, materials, ergonomics, and functionality[51]. Previous research has confirmed the influence of color, materials,

functionality, and ergonomics on product preference[50,52-55]. Therefore, this study will focus on shape as a visual feature to further examine its impact on customer satisfaction.

Based on this, we propose a research model that investigates customer satisfaction with computer products by incorporating variables derived from the Darwinian perspective, evolutionary psychology, and Gestalt principles. The independent variables in this model include typicality, novelty, unity, variety, connectedness, and autonomy from the Darwinian perspective. Proximity, closure, unity, variety, symmetry, and continuity from Gestalt principle. Typicality, novelty, performance, security, connectedness, and autonomy from Evolutionary psychology. These independent variables are hypothesized to influence customer satisfaction with computer products (dependent variable), as shown in Figure 1. The model will ultimately test the previously proposed hypotheses.

It should be noted that several core variables (e.g., unity, variety, typicality, and novelty) appear across multiple theoretical perspectives in this study. This repetition does not reflect conceptual redundancy, but rather intentional theoretical integration. Within the Unified Model of Aesthetics (UMA), these variables operate at different explanatory levels: Gestalt principles primarily account for perceptual organization, while Darwinian and evolutionary psychological perspectives explain cognitive, motivational, and adaptive functions. Accordingly, examining the same variables through complementary theoretical lenses allows for a more comprehensive understanding of how aesthetic features influence consumer satisfaction with computer products.

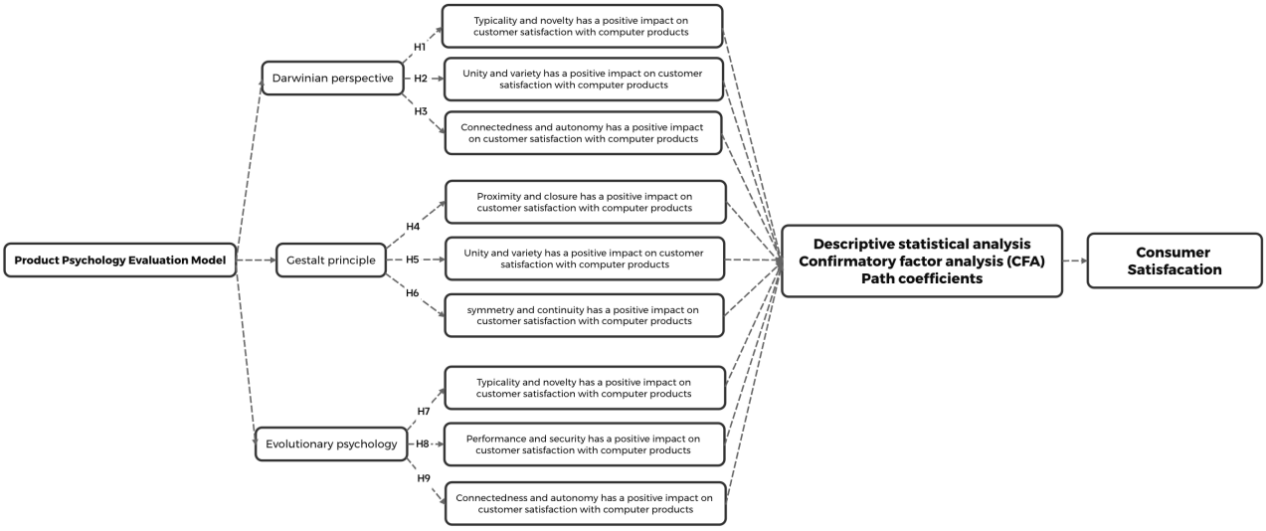

Figure 1. Research model.

3. Methods

3.1. Participants

To achieve the research objectives and examine the theoretical relationships among the constructs in the research model, we conducted an empirical study based on a post-positivist approach targeting adult computer consumers in China. Identifying relevant participants representative of the target user group was essential. Based on prior studies[54,56-58], We set a sample size of more than 200 participants, with an age range of 18 years and above. To ensure data validity, participants were grouped by age (18–25, 26–35, 36–45, and 46+ years) and included individuals from various fields, excluding those with a design background to avoid biased aesthetic assessments[57,59].

The survey link was distributed to 234 participants. After excluding 23 invalid or incomplete responses, data from 211 participants were included in the final analysis. Descriptive statistics showed that 54% of the participants were male and 46% were female. The largest proportion of participants (45%) were aged 26–35 years. Participants evaluated the computer product appearance attributes without prior knowledge of the specific purpose of the study. The entire data collection process adhered to ethical guidelines, including informed consent and participant confidentiality, and the data were collected via Google Forms. Detailed demographic information is presented in **Table 1**.

Table 1. This is a table.

		n	%
Gender	Male	114	54%
	Female	97	46%
Age	18–25 years old	59	28%
	26–35 years old	95	45%
	36–45 years old	42	20%
	46+ years old	15	7%
Total		211	100%

3.2. Stimuli selection

This study draws on the stimulus selection methods employed in related research[54,60-65]. First, the study identifies the variables and selects appropriate stimuli based on these variables [60]. Next, it determines suitable stimulus formats, which may include photographs, illustrations, 3D models, or actual product samples[61,62]. Considering sample size and cost factors, this study presents the stimuli in the form of images.

The next step involves designing the grouping, where combinations are created based on varying levels of the variables within the stimuli[63,64]. To ensure that the effect of each variable on computer consumer satisfaction could be observed, each stimulus was designed to highlight a specific variable while controlling for others. Specifically, across the three levels examined in this study, there were 18 independent variables related to product appearance. After removing duplicate variable names, 12 distinct independent variables were identified: typicality, novelty, unity, variety, connectedness, autonomy, proximity, closure, symmetry, continuity, performance, and security. Based on these 12 independent variables, 12 stimuli were selected for the study, as illustrated in **Figure 2**.

To ensure construct salience and content validity, the selected stimuli were reviewed prior to the main study by researchers with backgrounds in design and aesthetics. This review process confirmed that each stimulus clearly represented its intended appearance attribute and that the visual differences among stimuli were sufficiently salient while remaining comparable in overall form. Finally, the validation of the stimuli is conducted, and the steps and methods are detailed in the Instruments section.

Figure 2. Stimuli selection.

3.3. Instruments

This study employed a 7-point Likert scale (1 = "strongly disagree"; 7 = "strongly agree") to measure the relationship between customer satisfaction and computer product appearance characteristics. Specifically,

we measured customer satisfaction using six adapted items from Blijlevens et al. (2017), two items from Valencia-Romero and Lugo (2017), one item from Mandagi (2023), one item from Forbes (2020), one item from Pandey et al. (2021), and one item from Mather and McReynolds (2011). In total, the specified measurement model included 18 items, with the six items from Blijlevens et al. (2017) being repeatedly used across different levels[16-20,66].

To ensure linguistic accuracy, two bilingual authors translated the survey items into Chinese and then back into English. The original and translated versions were compared, and any minor discrepancies were resolved through discussion and negotiation. This process resulted in the finalized measurement items.

3.4. Data analysis

Before conducting hypothesis testing, we performed a descriptive statistical analysis to understand the demographic information of the study participants and to identify any potential outliers. Then, we used AMOS to conduct confirmatory factor analysis (CFA) to test the reliability and validity of the specified measurement model. To test the research hypotheses, this study used path coefficients from the structural model to estimate the effects of the independent variables (typicality, novelty, unity, variety, connectedness, autonomy, proximity, closure, symmetry, continuity, performance, and security) on the dependent variable (customer satisfaction).

4. Results

4.1. Measurement model validation

We used Confirmatory Factor Analysis (CFA) to assess the reliability and validity of the theorized measurement model. **Table 2** presents the results of the CFA for the three satisfaction constructs derived from Darwinian perspective, Gestalt principles, and evolutionary psychology. All standardized factor loadings (λ) range from 0.766 to 0.789, exceeding the recommended threshold of 0.70, indicating that each item loads strongly onto its intended latent construct. This demonstrates that the measurement items adequately represent the conceptual dimensions of typicality, novelty, unity, variety, proximity, closure, symmetry, continuity, performance, security, connectedness, and autonomy.

For internal consistency, all three constructs exhibit high composite reliability (CR = 0.899–0.903), which surpasses the commonly accepted minimum of 0.70. This indicates that the items within each construct consistently measure the same underlying concept. Additionally, the average variance extracted (AVE = 0.596–0.607) is above the 0.50 benchmark, confirming satisfactory convergent validity and demonstrating that more than half of the variance in the observed items is explained by the latent constructs.

Collectively, these results confirm that the three psychological satisfaction dimensions—Darwinian perspective, Gestalt principle, and evolutionary psychology—are measured reliably and validly. The strong loadings of typicality, novelty, unity, variety, connectedness, and individuality within both evolutionary and Darwinian perspectives support their conceptual alignment with cognitive and social mechanisms. Likewise, the Gestalt-based indicators (proximity, closure, symmetry, continuity) show robust contributions to perceptual aesthetic evaluation.

Overall, the CFA results indicate that the measurement model demonstrates sound reliability and convergent validity, providing a solid foundation for subsequent structural model analysis.

Table 2. Summary of result for confirmatory factor analysis (CFA).

Factors and Items	λ	CR[1]	AVE[2]
Satisfy (Darwinian perspective)		0.899	0.596
The typicality of this computer is appropriate	0.772		
The novelty of this computer is appropriate	0.774		
The unity of this computer is appropriate	0.769		
The variety of this computer is appropriate	0.772		
This computer makes me feel social belonging	0.766		
This computer emphasizes my individuality	0.779		
satisfy (Gestalt principle)		0.903	0.607
The proximity of this computer is appropriate	0.781		
The closure of this computer is appropriate	0.774		
The unity of this computer is appropriate	0.783		
The variety of this computer is appropriate	0.784		
The symmetry of this computer is appropriate	0.777		
The continuity of this computer is appropriate	0.777		
satisfy (Evolutionary psychology)		0.902	0.605
The typicality of this computer is appropriate	0.770		
The novelty of this computer is appropriate	0.789		
The performance of this computer appears to be trustworthy	0.777		
This computer appears to have security	0.784		
This design makes me feel social belonging	0.771		
This design emphasizes my individuality	0.776		

[1] *Composite reliability;* [2] *Average variance extracted.*

Table 3 reports the correlations among the three satisfaction constructs—Darwinian perspective, Gestalt principle, and evolutionary psychology—along with the square roots of their average variance extracted (AVE). The square root of each construct's AVE is presented on the diagonal in bold, while the off-diagonal values represent inter-construct correlations.

According to the Fornell–Larcker criterion, discriminant validity is established when the square root of the AVE for each construct exceeds its correlations with other constructs. As shown in Table 3, the AVE values for the Darwinian perspective (0.596), Gestalt principle (0.607), and evolutionary psychology (0.605) are all greater than the corresponding correlations across constructs (ranging from 0.235 to 0.273). This indicates that each construct shares more variance with its own measurement items than with other latent variables in the model.

The relatively low correlations among the constructs (0.235–0.273) further demonstrate that they capture conceptually distinct aspects of consumer satisfaction. Specifically, the Darwinian perspective reflects cognitive–social evolutionary responses, the Gestalt principle captures perceptual organization mechanisms, and evolutionary psychology emphasizes safety, performance, and social motivations. Their low intercorrelations confirm that these dimensions are empirically separable and not redundant.

Overall, the results provide strong evidence of discriminant validity, supporting the appropriateness of modeling the three psychological satisfaction constructs as distinct yet related components within the theoretical framework.

Table 3. Correlations between constructs and AVE values.

	Satisfy (Darwinian perspective)	Satisfy (Gestalt principle)	Satisfy (Evolutionary psychology)
satisfy (Darwinian perspective)	0.596[1]		
satisfy (Gestalt principle)	0.235[2]	0.607[1]	
satisfy (Evolutionary psychology)	0.273[2]	0.259[2]	0.605[1]

[1] Bold = AVE values; [2] Italics = correlations between the constructs.

4.2. Hypothesis testing

This study used path coefficients in the structural model to test the research hypotheses. First, the results show that, in the Darwinian perspective, typicality ($\beta = 0.772$; $p < 0.001$) 、 novelty ($\beta = 0.774$; $p < 0.001$) 、 Unity ($\beta = 0.769$; $p < 0.001$)、variety ($\beta = 0.772$; $p < 0.001$)、connectedness ($\beta = 0.766$; $p < 0.001$) and autonomy ($\beta = 0.779$; $p < 0.001$) have a positive impact on customer satisfaction. In summary, H1, H2, and H3 were supported.

Second, the results show that, in the Gestalt principle perspective, proximity ($\beta = 0.781$; $p < 0.001$)、closure ($\beta = 0.774$; $p < 0.001$)、 unity ($\beta = 0.783$; $p < 0.001$)、variety ($\beta = 0.784$; $p < 0.001$)、symmetry ($\beta = 0.777$; $p < 0.001$) and continuity ($\beta = 0.777$; $p < 0.001$) have a positive impact on customer satisfaction. Hence, H4, H5, and H6 were tenable.

Finally, the results show that, in the Gestalt principle perspective, typicality ($\beta = 0.770$; $p < 0.001$)、novelty ($\beta = 0.789$; $p < 0.001$) 、performance ($\beta = 0.777$; $p < 0.001$)、 security ($\beta = 0.784$; $p < 0.001$) 、connectedness ($\beta = 0.771$; $p < 0.001$) and autonomy ($\beta = 0.776$; $p < 0.001$) have a positive impact on customer satisfaction. All in all, H7, H8, and H9 were supported. The results of the hypothesis testing are summarized in **Table 4**.

Table 4. Results of hypothesis testing.

	Path	Estimates	Standard Error	p Value	Results
satisfy (Darwinian perspective)	T[1]→ satisfy	0.772	.022	< 0.001	Accept
	N[2]→ satisfy	0.774	.022	< 0.001	Accept
	U[3]→ satisfy	0.769	.022	< 0.001	Accept
	V[4]→ satisfy	0.772	.022	< 0.001	Accept
	C[5]→ satisfy	0.769	.023	< 0.001	Accept
	A[6]→ satisfy	0.772	.022	< 0.001	Accept
satisfy (Gestalt principle)	P[7]→ satisfy	0.781	.022	< 0.001	Accept
	C[8]→ satisfy	0.774	.022	< 0.001	Accept
	U[3]→ satisfy	0.783	.022	< 0.001	Accept
	V[4]→ satisfy	0.784	.022	< 0.001	Accept
	S[9]→ satisfy	0.777	.022	< 0.001	Accept
	CO[10]→ satisfy	0.777	.021	< 0.001	Accept

	Path	Estimates	Standard Error	p Value	Results
satisfy (Evolutionary psychology)	T[1]→ satisfy	0.770	.023	< 0.001	Accept
	N[2]→ satisfy	0.789	.022	< 0.001	Accept
	PE[11]→ satisfy	0.777	.023	< 0.001	Accept
	SE[12]→ satisfy	0.784	.022	< 0.001	Accept
	C[5]→ satisfy	0.771	.022	< 0.001	Accept
	A[6]→ satisfy	0.776	.022	< 0.001	Accept

[1] Typicality; [2] Novelty; [3] Unity; [4] Variety; [5] Connectedness; [6] Autonomy; [7] Proximity; [8] Closure; [9] Symmetry; [10] Continuity; [11] Performance; [12] Security.

5. Discussion

5.1. Interpretation of results

Firstly, the results of this study provide a comprehensive overview of the factors influencing computer consumer satisfaction. Specifically, at the Darwinian perspective level, one of the main findings of this study is that typicality and novelty positively impact customer satisfaction. This result aligns with previous research suggesting that individual behavior is still influenced by fundamental needs for achievement and security[21]. Typicality fulfills an evolutionary need for familiarity and safety[67]. Typicality fulfills an evolutionary need for familiarity and safety, while novelty caters to the intrinsic human drive for exploration and risk[64,68]. Furthermore, unity and variety also positively influence customer satisfaction. This is consistent with the perspective that Unity and variety balance these opposing desires, echoing the adaptation mechanisms of natural selection. For example, the study by Hekkert et al. (2016) demonstrates that while unity and variety are negatively correlated, they both contribute to customer satisfaction when controlled for each other[22]. Autonomy and connectedness also have a positive impact on customer satisfaction which supports previous research, such as studies by Hekkert (2017) and Teo (2024). These findings affirm that product designs that resonate with evolutionary preferences enhance consumer satisfaction by meeting deep-seated psychological needs[26,56].

Secondly, at the Gestalt principal level, one of the main findings of this study is that unity and variety have a positive impact on customer satisfaction. This result is consistent with Hekkert's (2016) "unity in variety" principle, which suggests that although unity and variety are negatively correlated, they both positively influence customer satisfaction and aesthetic preference when controlled for each other[30]. Proximity and closure also positively impact customer satisfaction. This finding supports previous research, such as Pandey's study, which found that proximity can lead to improved functionality and attractiveness in layouts[36]. Gerhardstein (2012) provide insights into how closure mechanisms operate within the visual system, indicating that closure can enhance perceptual facilitation in design contexts[37]. Additionally, the fundamental principles of Gestalt theory, including symmetry and continuity, positively influence customer satisfaction. This supports the model developed by Valencia-Romero and Lugo (2017), based on Gestalt principles such as symmetry and continuity, where a discrete choice experiment revealed that these principles enhance the aesthetic appeal of products and improve customer satisfaction[16].

Lastly, at the Evolutionary Psychology level, one of the main findings of this study is that connectedness and autonomy positively influence customer satisfaction. This result aligns with the perspective proposed by Hekkert (2019), which suggests that the two social needs—connectedness and autonomy—parallel the evolutionary drives for safety and achievement, enhancing aesthetic preferences and customer satisfaction through these dimensions[21]. Moreover, performance and security positively impact

customer satisfaction that aligns with previous Mather and McReynolds' research[19,20]. Performance and security emerged as vital attributes, reflecting the evolutionary preference for reliability and risk-aversion in decision-making. Typicality and novelty positively affect customer satisfaction. This finding is consistent with Qi's research, which explored a unified model of aesthetics based on Evolutionary Psychology to address customer satisfaction[43]. The study revealed that typicality and novelty were reaffirmed as critical factors influencing satisfaction, consistent with evolutionary drives for safety and achievement.

As expected, this study confirms a strong positive correlation between consumer satisfaction and the Darwinian perspective, Gestalt principle, and Evolutionary psychology. Satisfied consumers are likely to continue choosing computer products and recommending them to others. This finding is consistent with previous research, which highlights satisfaction as a crucial determinant of consumer loyalty[11,12]. In the context of computer products, satisfaction is driven by multiple factors, including near-evolutionary needs, holistic perceptions, and alignment with consumers' aesthetic expectations. Consumers who are satisfied with these aspects of computer products are likely to continue using them and recommending them to others.

5.2. Theoretical and practical implications

This study makes several theoretical contributions by clarifying and extending the Unified Model of Aesthetics (UMA) in the context of contemporary computer products. First, the findings provide robust empirical support for UMA's core aesthetic mechanisms, particularly the principles of unity–variety and typicality–novelty. Consistent with UMA, unity and variety jointly enhance aesthetic evaluation by balancing perceptual coherence and visual richness, while typicality and novelty operate together to reconcile evolutionary needs for safety and exploration. The significant effects of these dimensions confirm that UMA's foundational assumptions remain applicable to technology-oriented products, validating its explanatory power beyond traditional design objects and general consumer goods.

Second, and more importantly, this study extends UMA by strengthening its social–psychological dimension. While prior applications of UMA have primarily emphasized perceptual organization and cognitive appraisal, the present findings demonstrate that connectedness and autonomy play a crucial role in shaping consumer satisfaction with computer products. These results suggest that aesthetic experience is not limited to formal visual qualities but also involves symbolic meanings related to social belonging, identity expression, and personal agency. By empirically integrating connectedness and autonomy into the aesthetic evaluation process, this study highlights UMA as a framework capable of capturing how products function as carriers of social meaning and self-representation, thereby enriching its relevance to contemporary consumer contexts.

Finally, these theoretical insights offer practical implications for the design of technology-oriented products. The results indicate that successful computer product design should simultaneously address functional performance and symbolic communication. Designers are encouraged to balance visual coherence with variation, familiarity with innovation, and usability with identity expression. By aligning perceptual fluency, cognitive reassurance, and social signaling, product aesthetics can more effectively support positive user experiences and long-term satisfaction. From a broader perspective, this study suggests that UMA provides a valuable integrative framework for guiding design decisions in high-technology markets, where products are expected to perform reliably while also conveying meaning, individuality, and social affiliation.

5.3. Limitations and future research agenda

This study, while providing significant insights, has certain limitations. First, it was conducted within a specific cultural and geographical context, focusing on consumers from China. As such, the generalizability of the findings to regions or countries with different consumer cultures or behavioral characteristics may be

limited. Future research should replicate this study in diverse cultural contexts to examine the external validity of the structural model.

Second, this study primarily focused on psychological and aesthetic dimensions such as typicality, novelty, unity, variety, social connectedness, and autonomy as drivers of consumer satisfaction. While these are critical factors, the effects of branding and the psychological benefits of product usage were not included in the research scope.

Finally, future research incorporating branding effects and psychological benefits could provide a more comprehensive understanding of the factors influencing consumer satisfaction and loyalty in the context of computer products.

6. Conclusion

In conclusion, this study contributes to the literature on consumer behavior by clarifying how multiple psychological mechanisms jointly shape satisfaction with computer products. More importantly, it extends the Unified Model of Aesthetics (UMA) by demonstrating that its perceptual, cognitive, and social mechanisms remain robust in contemporary, technology-oriented product contexts. By integrating insights from Darwinian perspective, Gestalt principles, and evolutionary psychology within the broader lens of the UMA, this research not only applies but also extends UMA to the context of high-technology consumer products. The findings demonstrate that typicality, novelty, unity, and variety operate as core drivers of aesthetic balance, addressing evolutionary needs for safety, exploration, and optimal stimulation. Gestalt-based attributes such as proximity, closure, and symmetry further illustrate how perceptual organization enhances usability and visual coherence, enriching UMA's perceptual dimension. Likewise, the strong effects of connectedness, autonomy, performance, and security expand UMA's social and cognitive levels by showing how identity expression, risk mitigation, and functional reassurance jointly contribute to satisfaction.

The results highlight that consumer satisfaction is a multi-layered construct, emerging from the interaction of perceptual fluency, cognitive appraisal, and social meaning. This integrated pattern reflects an expanded interpretation of UMA, in which aesthetic experience is understood not only as a response to visual form but also as a process of meaning-making and identity alignment in technology-mediated consumption. These insights underscore the importance of evaluation strategies that acknowledge deep-seated human preferences while integrating both functional and emotional considerations in product design and assessment.

Despite its contributions, this study is limited by its single cultural context and restricted set of variables. Future research could deepen this extended UMA framework through cross-cultural comparisons and the incorporation of additional factors such as branding, psychological benefits, and technological innovation. Such efforts would provide a more comprehensive understanding of how computer products foster satisfaction and loyalty in an increasingly competitive global market.

Author contributions

Conceptualization, Y.H. and M.F.Y.; methodology, Y.H. and M.F.Y.; software, Y.H. and M.F.Y.; validation, Y.H., M.F.Y., and Y.-L.H.; formal analysis, Y.H., and S.C.; investigation, Y.H. and S.C.; resources, M.F.Y.; data curation, S.H.R.; writing—original draft preparation, Y.H.; writing—review and editing, M.F.Y.; visualization, S.H.R.; supervision, M.F.Y. and Y.-L.H.; project administration, M.F.Y.; funding acquisition, M.F.Y. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

The authors declare no conflict of interest.

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