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Scoping Review: Safety and Risk in Aesthetic Preference Determinants for Product Design

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Abstract

Designers should aim at resolving newness kinds of creativity that entail a tension between-metaphorically speaking-needs for safety and risky in order to arrive at a beautiful design. The Unified Model of Aesthetics suggests aesthetic preference for safety and risky, using principles of unity-in-variety, most advanced, yet acceptable and autonomous, yet Connected. However, there is a lack of evidence on the component framework of safety and risky of aesthetic pleasure and its overall determinants, especially in products design. the current review sought to understand the main determinants of aesthetic pleasure for safety and risky to predict the indicators of Perceptual, Cognitive and Social components in products design. a scoping review is conducted by reviewing English language literature published between 2011 and 2023 in three electronic databases, including Scopes, Science Direct and Emerald, using keywords and inclusion and exclusion criteria. the current study conducts a scoping review of the existing studies that indicate various determinate of unity and variety, typicality and novelty, connectedness and autonomy in aesthetic preference in order to identify the related indicators of safety and risky in product design. this scoping review contributed to the identification of comprehensive indicators of aesthetic pleasure for safety and accomplishment in products design.

INTRODUCTION

Three well known of esthetic principles are the Unity in Variety principle Post^[35], the MAYA principle Most advanced, yet acceptable Hekkert^[18], Loewy, 1951) social esthetic principle 'Autonomous, yet Connected Blijlevens^[7] and which explain esthetic appreciation as a result from maximizing three seemingly contradictory (safety and risk) dimensions both positively related to esthetic pleasure, respectively typicality and novelty, unity and variety, connectedness and autonomy. The Unified Model of Aesthetics (Hekkert^[17]) state that our aesthetic preferences depend upon a continuous battle between two evolutionary complementary, motivational drives and that the aesthetic sense has evolved to identify and value prospects for safety and accomplishment. The principles of unity-in-variety, most advanced yet-acceptable and autonomous yet-connected are considered manifestations of these conflicting urges at separate levels of stimulus processing, further, the principles are found to operate independently and jointly unity-in-variety has the strongest impact on aesthetic pleasure (Berghman and Hekkert^[4]). The theory that has been put forward in the literature for the workings of these types of maximization esthetic principles is the evolutionary psychological perspective on esthetic appreciation (Hekkert^[17]) that esthetic appreciation directs beneficial behavior for people's survival (Lindgaard and Whitfield^[26], too by and cosmid^[45] which we adapt to guide the development of our aesthetic principle.

Unity in Variety: Safety and Risk: The principle of unity-in-variety define as: the maximization of both unity and variety, to achieve a balance which interdependent and suppress each other's effect that offers the greatest aesthetic appreciation (Post^[35] that from the sensory processing of a stimulus for its own sake (Hekkert^[17]). According to Project UMA model (Hekkert^[17]), the trade-off between the needs for safety and accomplishment could form an underlying explanation for the unity-in-variety principle those humans seek both safety and accomplishment Whereas unity facilitates perceptual understanding can thereby fulfill a need for safety, perceiving variety bears the prospect of mastering new information, thereby fulfilling a need for accomplishment that the conditions of safety and risk will drive product preferences towards unity and variety, respectively (Post^[35]). Therefore, the current study conducts a scoping review of the existing studies that indicate various determinate of unity and variety in aesthetic preference to identify the related indicators of safety and risky in product design.

Most Advanced, Yet Acceptable: Safety and Risk: Our aesthetic preferences for objects are directed by two opposing evolutionary forces that the preservation of life and the conditions of growth (Damasio^[13]). Typical (familiar) because it leads to fulfill the need for safety, however, we are also drawn towards novelty to fulfill the need for exploration. Studies showed that people prefer novel designs if the novelty does not affect typicality preferred are products with an optimal combination of both aspects (Hekkert^[18]), thus, they influence the more basic evolutionary needs for safety and exploration (Clementine Thurgood^[11], Hekkert^[17] Furthermore, the conditions of safety and risk will drive product preferences towards novelty and typicality, respectively (Clementine Thurgood^[11]). Therefore, the current study conducts a scoping review of the existing studies that indicate various determinate of typicality and novelty in aesthetic preference to identify the related indicators of safety and risky in product design.

Autonomous, yet Connected: Safety and Risk: Social esthetic principle, autonomous, yet connected, (Blijlevens and Hekkert^[7]) focus on the degree to which a product design potentially meets our social concerns of relatedness and autonomy (Deci and Ryan^[14]). The need for connectedness is described as an inherent social need (Deci and Ryan^[14]) and to have a sense of closeness with others (Baumeister and leary^[3] Brewer^[8]). The desire to form and maintain social bonds has survival and reproductive benefits (Ainsworth^[1], Bowlby^[9]). human beings and maintaining group affiliation, humans nurture their evolutionary need for safety and people also have an inherent need to feel autonomous Lynn and Harris^[30], Lynn and Snyder^[31]. Connectedness and autonomy are not only warranted by evolutionary theory, but also by the fact that these concerns have been shown to be of importance in the consumption context (Fisher and Price^[16], Chan^[12]). Therefore, the current study conducts a scoping review of the existing studies that indicate various determinate of connectedness and autonomy in aesthetic preference to identify the related indicators of safety and risky in product design.

The Oretical Base of the Scoping Review: The conceptual structure of this study is developed from the Project UMA Framework on a Unified Model of Aesthetics in 2012. They have suggested that a designed artifact in many three different components, including unity and variety (perceptually), typicality and novelty (cognitively), connectedness and autonomy (socially), the model predicts that the aesthetic pleasure we gain from for designed artifacts arises out of a delicate balance between ranges of

opposing forces. They argued that the aesthetic pleasure associated with everyday objects is the enjoyment produced by experiencing how designers have chosen to realize their aims. They also suggested the concept of balance between two opposing forces to seek our need for safety. The term safety refers to providing (e.g., order, control, belonging) the product design of unity, typicality connectedness. the other force propels us toward accomplishment (e.g., novelty, uniqueness, challenge). Whereas the other force propels us toward accomplishment (e.g., novelty, uniqueness, challenge) the product design of variety, novelty autonomy, at the same time, it is risky. In all these cases, two force leads to a pleasurable aesthetic response. Later, the project team to empirically test this theoretical framework suggested six determinants for aesthetic preference derived from the main three ways: unity and variety, typicality and novelty, connectedness autonomy. Therefore, the context of this review was in line with the suggested determinants for aesthetic pleasure from designed artifacts by Project UMA (Fig. 1).

MATERIALS AND METHODS

The current scoping review is applied in accordance with the framework of Arksey and O'Malley (2005), aiming to review the related determinants of the Project UMA (Unity and Variety, Typicality and Novelty, Connectedness and Autonomy) of aesthetic preference for safety and risky in product designs to predict designers in achieving a balance between safety and attractiveness indicators. The scoping review is an ideal method for a comprehensive coverage of evidence that provides a comprehensive coverage of a body of existing literature, especially for the literature that has not been comprehensively reviewed. It highlights the nature, methods main findings of the initial evidence on a topic (Arksey and O'Malley 2005). Arksey and O'Malley (2005) highlighted five steps for scoping reviews, including a) specifying research objectives, b) identifying relevant literature, c) screening and selecting the studiesd) collecting the data (included studies)e) summarizing and writing up the results. This study also used Mendeley and ATLAS. ti 9 to analyses the data and material collected.

Search Strategy: The electronic scoping search will be conducted in December 2023 for studies published between 2011 and 2023. The databases searched included Scopus preview, Science Direct and Emerald Online. The current review covers three main research components of Project UMA, including unity and variety, typicality and novelty, connectedness and autonomy, six main variables. In addition, six main

variables using hierarchical search and keywords are applied in this study, as shown in (Table 1). Quotation marks, brackets and truncation are used for advanced searches as needed. The search string is only applied to the title, abstract and keywords.

Inclusion Criteria: The inclusion and exclusion criteria for the scoping review were as follows: (a) Year and language of studies: studies published in English between 2011 and 2023 were included. Studies published before 2011 and in a language other than English were excluded. The project UMA: a Unified Model of Aesthetics is an empirical test of this theoretical framework first proposed by Prof. Dr. Paul Hekkert (2012) and his core team of international partners (2011-2016). Therefore, the current study reviewed literature published between 2011 and 2023. (b) Type of studies: only quantitative studies, non-quantitative studies were excluded to ensure the quality of the included studies. (c) Focus of the studies: based on the study objective, the included studies must focus on aesthetic preferences and their determents in product design. Studies focusing on aesthetic preferences and their determinants in product design were excluded. (d) Type of participants: Included studies should focus on adults aged 18 years and older. (e) Quality assessment: Selected studies should pass the quality assessment of the BEME framework as described in the quality assessment section to ensure the quality of the scoping review. The excluded studies are irrelevant and did not pass the BEME quality assessment.

Study Quality Assessment: The quality assessment tool is crucial for identifying the quality of the non-rigorous studies. The BEME quality framework was used to assess the quality of the selected studies. The BEME quality framework includes 11 indicators for quantitative studies and 10 indicators for qualitative and review studies. It provides a consistent approach for the assessment of the selected studies. Each BEME indicator is scored as 1 = fulfilled or 0 = not fulfilled. Each study should meet at least seven indicators to be considered high quality. Studies with a score of less than three are considered weak, studies with a score of four to seven are considered moderate studies with a score of seven or more are considered strong and included. Two authors independently performed the quality assessment for each selected study to check the consistency and reliability of the study. Disagreements were resolved by online discussion between the two authors the final discussion of included studies was conducted by the entire team. Only seven studies were excluded based on the quality assessment. The quality assessment process is shown in (Table 2).

Search Outcome: A total of 1456 studies were identified from the three electronic databases: Scopus Preview (n = 616), Science Direct (n = 636), Emerald Online (n = 204) between 2011-2023 as shown in Fig. 2. Additional records (n = 7) are also identified from manual searches of other sources and references. In addition, six main variables are applied in this study using hierarchical search methods and keywords as shown in Table 1. For advanced searches, the truncation and is used where necessary. The search string is only applied to All fields. As search criteria, the authors used the six main terms related to security: unity and diversity, typicality and novelty, connectedness and autonomy, e.g. Search 1: Scopus Preview (n = 8), Science direct (n = 65), Emerald Online (n = 141) Search 2: Scopus Preview (n = 345), Science direct (n = 276), Emerald Online (n = 38) Search 3: Scopus Preview (n = 53), Science direct (n = 195), Emerald Online (n = 25). After removing duplicate studies (n = 155) and including studies published in non-English languages (n = 8), a total of 1300 studies remained, of which 1157 were excluded by title screening (n = 874) and abstract screening (n = 283). Reports screened for retrieval 143 studies, of which reports were not retrievable (n = 3), only available in abstract form (n = 2), not downloadable (n = 1). Reports assessed for full text eligibility (n = 140), of which 101 studies were excluded: no relevant data (n = 73), not related to product design (n = 11), non-quantitative research (n = 10) and failed quality assessment (n = 7). Finally, the following studies were included in the quantitative review (n = 39).

RESULTS AND DISCUSSIONS

Description of the Selected Studies: The scoping review yielded 1463 studies published between 2011 and 2013 only 39 studies were selected, of which four studies from both unity and variety (10.25%); twenty-six studies from typicality and novelty (66.66%), of which five studies from both typicality and novelty, seven studies from typicality only fourteen studies from novelty only, two studies from connectedness and autonomy (5.12%), of which one study from both relatedness and autonomy, one study from connectedness only (Table 4) the remaining seven studies from aesthetic preference (17.94%), of which five studies (12.82%) from aesthetic pleasure, two studies (5.13%) from aesthetic appreciation (Table 4). All the reviews were quantitative in nature (Table 3). It was organized into ten themes, including stimulus, design features, consumer emotional, product category, product appearance, safety and risk, consumer behavior, design evaluation, aesthetic principles (Gestalt principles, unity in variety, most advanced yet acceptable autonomous yet connected), regulatory focus.

Design Features: The scoping review showed that about one-third of the reviewed studies (n = 13 studies, 33.33%) have significant results on the 'Design features' determinant from aesthetic preference of unity and variety typicality and novelty for determinant is presented in nine important codes (Table 4). First, the codes are mentioned in two studies (n = 2 studies, 5.13%) and included two codes, as the indicators of unity and variety: a) complexity (n = 2 studies, Post^[35], Van Geert^[46]). b) order (n = 1 study, Van Geert^[46]) The complexity and order are indicated as a design features determinant in eight product designs, including lamps, espresso machines, motorcycles, car interiors, USB-sticks, tables (Post^[35]) and pairs (Van Geert^[46]). Second, design features is highlighted in in seven study (n = 7 study 17.95%) and included seven codes, as the indicators of typicality and novelty. A) About typicality and novelty: a) Augmented reality (AR) (n = 1 study. The augmented reality (AR) is indicated as a design features determinant in one product design, including chairs form typicality and novelty. B) About typicality: a) objective Measures (n = 1 study Mayer and Landwehr^[32]). b) processing fluency (n = 1 study, Mayer and Landwehr^[32]). c) complexity (n = 1 study, Lee and Shin^[25]). d) atypical (n = 2 studies, Blijlevens Gemser^[6] Landwehr and Wentzel^[24]). The objective measures, processing fluency, complexity and atypical are indicated as a design features determinant in three product designs, including chairs (Lee and Shin^[25] Landwehr and Wentzel^[24]), cars (Mayer and Landwehr^[32], water bottle (Blijlevens, Gemser^[6]) from typicality. C) About novelty: a) complexity (n = 3 studies, Honda^[19], Sung^[42], WK Hung^[47]). b) atypical (n = 1 study Sung^[42]). c) design newness (n = 3 studies, Mugge and Dahl^[33] Seifert and Chattaraman^[39], Sung^[42]). d) trendiness (n = 1). The complexity, atypical, design newness, trendiness are indicated as a design features determinant in seven product design, including digital camera (Mugge and Dahl^[33]), iPhone OS icons and Xiaomi smart phones icons (Sung^[39]), chairs, Digital cameras, washing machines and hair dryers (Mugge and Dahl^[33]), Women's tops (Seifert and Chattaraman^[39]) from and novelty. Thirdly, the codes are mentioned in one study (n = 1 study, 2.56%) and included one code, as the indicators of connectedness and autonomy: a) Functionality (n = 1 study, Blijlevens and Hekkert^[7]). The functionality is indicated as a design features determinant in five product designs, including Sunglasses, bicycle, stapler, backpack sneaker (Blijlevens and Hekkert^[7]). These significant codes of design features refer to the availability of Complexity, Order, Augmented Reality (AR), Objective Measures, Processing Fluency, Atypical, Design Newness, Trendiness, Functionality, which is investigated in Perceptual, Cognitive and Social components. Therefore, the design features determinant of

aesthetic preference is a prevalent theme in the literature from twenty product design. It was described as a set of attributes and characteristics that predicts the aesthetic preference of product design (Table 4).

Consumer Emotional: The scoping review showed that the most common determinant of the reviewed studies ($n = 8$ studies, 20.51%) have significant results on the Consumer Emotional determinant from aesthetic preference of unity and variety, connectedness aesthetic pleasure for determinant is presented in six important codes (Table 4). First, the codes are mentioned in two studies ($n = 2$ studies 5.13%) and included one code, as the indicators of unity and variety: a) individual difference (age and personality) ($n = 2$ studies Post^[35], Van Geert^[46]). The 'individual difference (age and personality)' is indicated as a consumer emotional determinant in eight product designs, including lamps, espresso machines, motorcycles, car interiors, USB-sticks, tables (Post^[35]) and pairs (Van Geert^[46]). Second, the codes are mentioned in four studies ($n = 4$ studies, 10.26%) and included three codes, as the indicators of novelty: a)

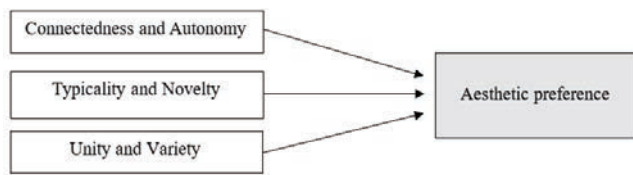


Fig. 1. Aesthetic preference framework adapted from Project UMA: a Unified Model of Aesthetics (Hekkert, P., 2012)

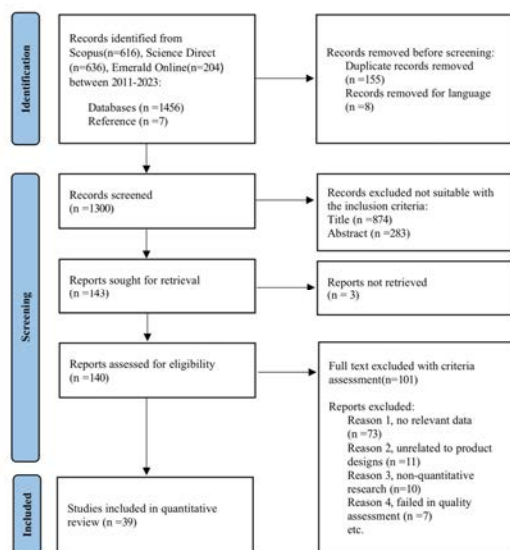


Fig. 2. Studies selection flowchart

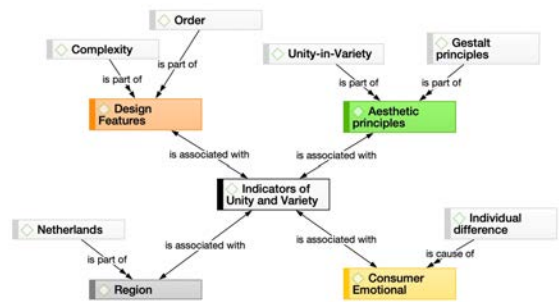


Fig. 3. Potential indicators of e esthetic preference in cognitive component



Fig. 4. Potential indicators of e esthetic preference in cognitive component

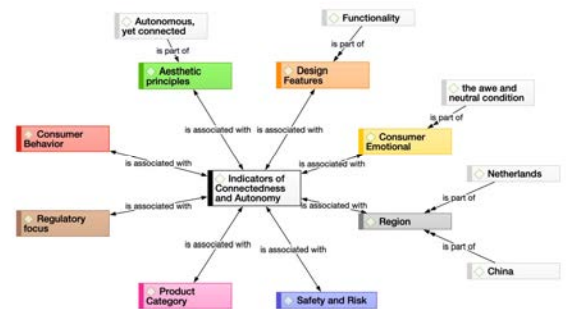


Fig. 5. Potential indicators of e esthetic preference in social component

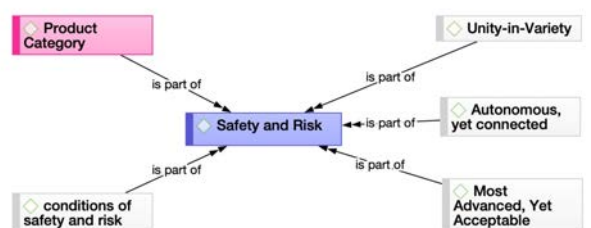


Fig. 6. Potential indicators of safety and risky in aesthetic preference

(Clementine Thurgood et al., 2014)	To explore how typicality and novelty together affect the aesthetic pleasure of product designs and how safety and risk conditions impact this effect.	Method: Quantitative Empirical Research Respondents: n=256. Stimuli Selection: Lamps, Clocks Setting: Australia (Consumer panel)	DV: Aesthetic pleasure IV: Typicality and novelty MV: Product category, Safety and Risk	The results reaffirm that people favor a balance between typicality and novelty in product designs for aesthetic pleasure, while the impact of safety and risk on preferences for novelty or typicality remains unclear.
(Faerber & Carbon, 2013)	To investigate how imitators in product design, akin to those adopting features from successful innovators like the touch screen of Apple's iPhone, can gain acceptance and to analyze the dynamics of typicality and liking concerning these innovative features.	Method: Quantitative empirical research using a survey. Respondents: n=40 Stimuli Selection: chairs. Setting: Not specified	DV: Typicality and liking. IV: Similarity (the adaptor and imitator designs).	The study found significant changes in typicality and liking for imitators being highly similar to the original.
(Honda et al., 2022)	To develop a shape generation system that is applicable to a variety of product shapes and to use the formulated novelty and complexity to determine the product shape.	Method: Quantitative empirical research using a survey. Respondents: n=24. Stimuli Selection: butterflies and automobiles. Setting: Tokyo (University of Tokyo)	DV: Product Shape IV: Novelty and complexity	The study found that novelty and complexity, when controlled through a shape generation system, can independently influence the aesthetic appreciation of shapes in terms of perceived beauty and interest.
(Hu et al., 2022)	This study aims to introduce a method that assists designers in applying aesthetic design principles to improve the attractiveness of product appearance and formulas for aesthetic measurement based on aesthetic design principles are also developed.	Method: Quantitative research methodology using mathematical analysis and case studies. Stimuli Selection: Digital camera.	DV: Aesthetic preference. IV: Application of aesthetic design principles (balance, proportion, simplicity, unity, symmetry, contrast, harmony, etc.).	The study presents formulas for aesthetic measurement based on design principles, demonstrating how they can quantify and guide the improvement of product appearance, especially for novice designers.
(J Bijlevens et al., 2017)	To address inconsistencies in existing measurement scales and validate determinants of aesthetic pleasure.	Method: Quantitative empirical research using a survey. Respondents: n=699. Stimuli selection: cameras, motorcycles, chairs, and websites, sunglasses, and sanders. Setting: Australia, Netherlands, and Taiwan.	DV: Aesthetic pleasure. IV: Typicality and novelty, unity and variety.	The findings resulted in a final scale consisting of five items that reliably capture aesthetic pleasure.
(Janneke Bijlevens et al., 2014)	To address the inconsistency in scales used for measuring aesthetic pleasure by developing and validating a new scale that measures aesthetic pleasure and its determinants.	Method: Quantitative empirical research using a survey. Respondents: n=108 Stimuli Selection: Cameras, motorcycles, chairs, web designs. Setting: Australia, Netherlands (Consumer panel)	DV: Aesthetic pleasure. IV: Typicality, novelty, unity, and variety,	The findings highlight the creation of a scale that effectively measures aesthetic pleasure and its determinants, offering both theoretical and practical implications for design research and guiding designers.
(Jos' et al., 2014)	To explore the use of Gestalt principles as a quantitative measure of aesthetics in design, specifically using automotive wheel rims as a study subject.	Method: Quantitative empirical research using computational models and surveys. Respondents: n=200. Stimuli Selection: wheel rims Setting: Amazon Market Turk	DV: Aesthetic preference. IV: Gestalt variables. CV: Complexity.	The study shows that Gestalt principles effectively measure aesthetics, enhancing aesthetic preference, with similar preferences for designs sharing the same Gestalt level despite different shapes.
(Landwehr & Wentzel, 2013)	To examine whether the relationship between design typicality and aesthetic preferences is moderated by the degree of exposure.	Method: Quantitative research with observations, data analysis, and experiments. Respondents: n=509. Stimuli Selection: Car. Setting: Representative of car buyers.	DV I: Aesthetic liking and sales IV I: Typicality and exposure MV: Exposure level	Aesthetic liking for typical car designs is higher at lower exposure levels. Atypical car designs are liked more at higher exposure levels. Atypical cars may achieve greater sales success over time. There's an interaction between design typicality and exposure affecting aesthetic liking and car sales.
(Lee & Shin, 2020)	To examine the effect of apparel names (atypical vs. typical) and visual complexity (complex vs. simple design) on mental imagery and attitudes toward apparel products.	Method: Quantitative empirical research using a between-subject experimental design. Respondents: n=90. Stimuli Selection: Sweater. Setting: United States	DV: Mental imagery elaboration and quality, Apparel product attitudes. IV: Apparel names (typical vs. atypical) and Visual complexity (complex vs. simple)	These findings suggest that in an online retail context, the use of atypical names can be more effective for simpler designs, enhancing mental imagery and positively influencing consumer attitudes.
(Liu et al., 2020)	Investigate how consumers' regulatory focus (promotion vs. prevention) influences their preference for product design novelty.	Method: Quantitative empirical research using experimental design Respondents: n=872. Stimuli Selection: portable hair dryer, washing machine, vacuum cleaner and smartphone. Setting: Undergraduate business students.	DV: Consumer preference and Processing fluency. IV: Novelty and regulatory focus CV: Product Type	Preference for design novelty is contingent on regulatory focus, with promotion-focused consumers preferring novel designs, especially for utilitarian products. Hedonic products are preferred in their novel form by all consumers, irrespective of regulatory focus.
(Loos et al., 2022)	Evaluate if design principles, particularly Unity-in-Variety, improve the aesthetic appeal of topology-optimized shapes.	Method: Quantitative empirical research using experiment and assessment. Respondents: n=37. Stimuli Selection: Topology optimization chairs and beams. Setting: Delft (students)	DV: Visual appeal (Aesthetic evaluations). IV: Unity-in-Variety (Gestalt principles).	The research, guided by the Unity-in-Variety principle, finds that enhancing unity in topology-optimized designs (like chairs and beams), using Gestalt principles, makes them visually more appealing. This balance increases aesthetic appreciation.
(Luo et al., 2022)	To investigate consumer aesthetic preferences for taillight shape design. To provide insights into visually appealing shapes for vehicle designers and manufacturers.	Method: Quantitative empirical research using experiment and assessment. Respondents: n=39 Stimuli Selection: Taillight. Setting: Driving licenses and drove regularly.	DV: Aesthetic preference. IV: Taillight shape (contour features, length, orientation).	Taillight shapes with contour features or medium length were more aesthetically preferred by consumers. Horizontal taillight shapes were preferred over vertical ones.
(Mayer & Landwehr, 2018a)	The study aims to evaluate product design typicality for predicting market success. It presents objective methods to quantify design typicality in cars, testing these against consumer opinions on aesthetic appeal and ease of processing.	Method: Quantitative Empirical Research using survey. Respondents: n=195. Stimuli Selection: cars Setting: Not specified (Amazon's M Turk platform).	DV: Aesthetic liking, processing fluency. IV: Design typicality (feature point measures and image correlation measures.).	Design typicality greatly influences car aesthetics. Algorithmic methods can accurately assess design typicality. Processing fluency slightly influences how typicality affects aesthetic preference. For mental analysis, subjective measures are best, but objective measures suit economic studies better.
(Mugge & Schoormans, 2012a)	To explore the level of novelty of a product appearance as a general design guideline to evoke positive associations about the product's performance quality.	Method: Quantitative empirical research using survey Respondents: n=156. Stimuli Selection: washing machines, single-lens reflex cameras. Setting: A consumer household panel.	DV: Product perception IV: Novelty scale.	This study finding that the level of novelty of a product appearance positively affects the perceived performance quality of the product.
(Mugge & Schoormans, 2012b)	To enhances our understanding of the relationship between aesthetics and usability by investigating the effects of novelty in product appearance on the apparent usability of a product.	Method: Quantitative empirical research using survey Respondents: n=132. Stimuli Selection: Washing machines and digital cameras. Setting: A consumer panel.	DV: Aesthetics and usability IV: Novelty CV: Color or shape	Novelty in a product appearance negatively affects their expectations of a product's usability at the point of sale, and novices are more likely to use the level of novelty as a cue for a product's apparent usability than experts.
(Mugge & Dahl, 2013)	To empirically test how design newness affects consumer response to product innovations.	Method: Quantitative empirical research using survey Respondents: n=130. Stimuli Selection: Digital cameras, washing machines, and hairdryers. Setting: A consumer panel.	DV: Innovativeness of the product IV: Type of innovation, design newness, product category CV: Attractiveness, ease of use, functionality, and perceived quality.	Radical innovations that are not too different in design receive better evaluations and are seen as easier to learn. This happens because consumers find it hard to apply their knowledge to completely new products with unfamiliar features.
(Post et al., 2016)	Explore how unity and variety influence aesthetic appreciation in product designs, addressing the lack of empirical research on this topic. Assess the impact of visual complexity and individual differences in regulatory focus.	Method: Quantitative empirical research using experimental design. Respondents: n=178. Stimuli Selection: lamps, espresso machines, motorcycles, car interiors, USB-sticks and tables. Setting: Dutch (consumer panel)	DV: Aesthetic appreciation. IV: Unity and variety.	Unity and Variety: Both positively affect aesthetic appreciation, suppressing each other's influence. Optimum Balance: Designs with an optimum unity-variety balance are preferred. Dominant Factor: Unity is the dominant factor, enhancing the appreciation of variety.
(Post et al., 2023)	Explore why consumers aesthetically appreciate touching products, focusing on the modality-independent application of the Unity-in-Variety principle.	Method: Quantitative empirical research using experimental design. Respondents: n=87. Stimuli Selection: car key remotes. Setting: Dutch (students).	DV: Esthetic appreciation. IV: Unity and variety.	Unity-in-Variety principle applies to tactile esthetic appreciation. Both independently contribute to tactile esthetic appreciation. Highest appreciation when both unity and variety are maximized simultaneously.

(Radford & Bloch, 2011a)	To examine the types of responses elicited by consumers when exposed to new products. .	Method: Quantitative empirical approach using a survey Respondents: n=110. Stimuli Selection: hand vacuums, espresso, pens, toothbrushes. Setting: Midwestern University.	DV: Aesthetic Responses and Affective Reactions, Aesthetic evaluations and Symbolic associations. IV: Newness	This finding that higher levels of novelty elicit more affective responses.
(Rambardhan & Bisht, 2022)	To compare user perceptions of product designs presented through augmented reality (AR) versus pictorial digital images, focusing on how these different modes of visual representation influence the perceived novelty and typicality of products.	Method: Quantitative empirical approach using a survey Respondents: n=308 Stimuli Selection: Chairs Setting: UG and PG Design students	DV: Pictorial and augmented reality (AR) IV: Novelty and typicality	Augmented reality (AR) presentations of products were preferred over traditional pictorial images, achieving 6–8% higher ratings in terms of novelty and typicality. This indicates AR could significantly improve user engagement and satisfaction by more effectively showcasing a product's aesthetic attributes.
(Sasaki et al., 2023)	To develop a method for quantifying the 'novelty' of industrial product designs based on the free-energy principle and to apply this to the assessment of aesthetic liking.	Method: Quantitative empirical research using particle swarm optimization Respondents: n=42 Stimuli Selection: Automobile. Setting: Japan (students, automobile clubbers)	DV: Aesthetic liking IV: Novelty And complexity. CV: Sample shape generation	The study confirmed that the Gaussian curvature KL divergence represents the difference between a typical shape and a target shape can be applied to evaluation of aesthetic liking.
(Seifert & Chattaraman, 2017)	To examine the individual and joint effects of collative design factors, complexity, and novelty, on aesthetic response to apparel products; and whether the influence of these factors is moderated by consumers' centrality of visual product aesthetics (CVPA).	Method: Quantitative empirical research using mixed factorial experimental design. Respondents: n=260. Stimuli Selection: Women's tops. Setting: Southern United States (undergraduate students)	DV: Aesthetic response. IV: Design complexity and novelty. MV: Moderating role of CVPA	Consumers' aesthetic response was more positive for high than low complexity and novelty apparel designs. High CVPA consumers were more distinguishing than low CVPA consumers with respect to novelty in apparel designs.
(Seifert & Chattaraman, 2020)	To provide a holistic understanding of how visual storytelling influences the objective and subjective cognitive responses of consumers, namely objective aesthetic impression and subjective aesthetic association, and aesthetic judgments in response to differing levels of novelty in design innovations.	Method: Quantitative empirical research using mixed factorial experimental design. Respondents: n=263. Stimuli Selection: Chairs. Setting: Female US consumers.	DV: Aesthetic judgments. IV: Novelty and visual design stories.	Consumers respond more favorably to product designs that exhibit moderate novelty compared to high novelty and prefer products that include visual design stories.
(Suhaimi et al., 2023)	To propose an index of novelty for industrial products which is applicable for evaluation of aesthetic liking.	Method: Quantitative empirical research using experiment. Respondents: n=207 Stimuli Selection: Industrial boilers Setting: Australia, China (professionals and non-professionals).	DV: Aesthetic preference. IV: Typicality and novelty. MV: Geographical location (China and Australia) and professional experience.	The results are unequivocal: novelty makes a medium contribution, while typicality makes a low contribution. This is inconsistent with the notion that typicality is a major determinant of aesthetic preference, suggesting that the current models of aesthetic preference need elaboration.
(Suk, 2023)	Explore how consumer preferences for products are influenced by attribute resemblance, specifically examining the moderation effect of attribute familiarity.	Method: Quantitative empirical research using mixed-design experiments. Respondents: n=315. Stimuli Selection: Smart watches, Digital camera, Wine fridges. Setting: Students.	DV: Attitude towards the product and choice. IV: Attribute resemblance (low vs. high) and attribute familiarity (low vs. high). MV: Attribute familiarity.	Positive impact of attribute resemblance on attitude is stronger when attributes are less familiar. Attribute resemblance positively influences choice with less familiar attributes but negatively influences choice with more familiar attributes, suggesting heightened competition with similar options.
(Sung et al., 2019)	To explore that novelty does not result in liking but instead, evokes interest—a similar but functionally different positive affective experience.	Method: Quantitative empirical research using experiments. Respondents: n=159. Stimuli Selection: iPhone iOS Setting: Online consumer panel.	DV: Interest of the product and Liking of the product. IV: Novelty. MV: Motivation contexts.	These findings suggest that consumers' paradoxical tendency to favor both familiarity and novelty are manifested in ways beyond a general emotional valence account. Specifically, familiarity appears to evoke liking whereas novelty appears to evoke interest.
(Sung et al., 2022)	to examine whether (1) deviation of design (i.e. objective design newness) is distinct to consumers' perception of design newness (i.e. subjective design newness) and (2) subjective design newness rather than objective design newness evokes the emotion of interest and enhances product evaluation.	Method: Quantitative empirical research using quasi-experiments Respondents: n=402. Stimuli Selection: iPhone OS icons and Xiaomi smartphones icons. Setting: Online consumer panels) and Australia (students).	DV: Liking IV: Objective vs subjective Design newness and interest	Across five quasi-experimental studies, the authors found that (1) consumers do not necessarily perceive an objectively new design to be subjectively new; (2) subjective design newness, but not objective design newness, evokes interest and (3) interest, in turn, enhances product evaluation and behavioral intention toward an innovation.
(Talke et al., 2017)	To demonstrate that the effect of design newness on sales performance of new products is different for competing products, other products in the brand portfolio, and the product's predecessor perspectives.	Method: Quantitative empirical research using date source and Online experiment. Respondents: n=86. Stimuli Selection: Car models and smartphone concepts. Setting: Germany for car data, USA (Amazon's Mechanical Turk service).	DV: Sales performance. IV: Design newness Covariate: Product category, Brand category, Product line category	Design newness significantly impacts sales, with optimal levels varying depending on the reference perspective. The study suggests that while novel designs are effective for differentiation, extreme deviations might not always be favorable.
(Van Geert, 2021)	To examine factors contributing to aesthetic preferences for images of neatly organized compositions, focusing on order, complexity, and the balance between them.	Method: Large-scale online study with preference choices and personality questionnaires. Respondents: n=421. Stimuli Selection: image pairs. Setting: Dutch or English (nationality or mother tongue Understand).	DV: Aesthetic preference. IV: Order (unity) and Complexity(variety). MV/Covariate: Personality traits.	The study highlights that both stimulus and person (age and personality) properties related to order, complexity, and the balance between order and complexity, and thus influence aesthetic preferences. The balance between order and complexity involves no interaction, and independently so, and the stimulus and person (age and personality) interact in determining aesthetic appreciation.
(WK Hung, 2012)	To investigated three fundamental dimensions of product semantics – trendiness, complexity, and emotion influences on novelty and aesthetic preference.	Method: Quantitative empirical research using surveys. Respondents: n=60. Stimuli Selection: chairs. Setting: Ming-Chi University of Technology in Taiwan, (students).	DV: Aesthetic preference. IV: Novelty. CV: Complexity: simple – complex and emotion: rational – emotional and trendiness: traditional – modern.	The results indicate that the three fundamental dimensions of product semantics—trendiness, complexity, and emotion—serve as predictor variables for novelty. Trendiness had the greatest influence, followed by complexity and, lastly, emotion. These dimensions affected aesthetic preference differently, with both complexity and emotion showing inverted-U relationships, while trendiness exhibited a small positive linear relationship with aesthetic preference.
(Yang et al., 2021)	The purpose of this paper is to explore the effect of the feeling awe on individuals' endorsement of conformist attitudes in consumption choices and the mediating role of social connectedness in generating this effect.	Method: Quantitative empirical research using surveys. Respondents: n=1301. Stimuli Selection: vase. Setting: China (students and adults)	IV: Awe. DV: Consumer conformity. MV: Social connectedness.	This research shows that both dispositional awe and induced awe can increase individuals' preferences for majority-endorsed vs. minority-endorsed choice alternatives in subsequently unrelated consumption situations, and this effect is mediated by perceptions of social connectedness with other decision- makers.

DV: Dependent variable, IV: Independent variable, CV: Control Variable.

Table 4: Determinants and predictors of aesthetic preference in product design

Determinant	No.	Category	Items (Codes)	No.	Product Design	Region	Reference
Design Features	13 studies (33.33%)	Unity and Variety	Complexity	2 Studies (5.13%)	Lamps, espresso machines, motorcycles, car interiors, USB-sticks, tables	Netherlands	(Post et al., 2016)
			Order		Pairs	Netherlands	(Van Geert, 2021)
		Typicality and Novelty	Augmented reality (AR)	7 studies (17.95%)	Pairs	Netherlands	(Van Geert, 2021)
			Objective Measures		Chairs	Not specified	(Rambardhan & Bisht, 2022)
			Processing Fluency		Cars	Not specified	(Mayer & Landwehr, 2018)
	Novelty	Complexity	Complexity	Not specified	Chairs	USA	(Lee & Shin, 2020)
			Atypical		Water bottle	Eurozone	(Bijlevens, Gemser, et al., 2012)
			Complexity		Chair	Not specified	(Landwehr & Wentzel, 2013)
			Atypical		Digital camera	Japan	(Honda et al., 2022)
			Design Newness		iPhone OS icons and Xiaomi smartphones icons	Not specified	(Sung et al., 2022)
Consumer Emotional	8 studies, (20.51%)	connectedness and autonomy	Atypical	1 Study (2.56%)	iPhone OS icons and Xiaomi smartphones icons	Taiwan	(WK Hung, 2012)
			Design Newness		Chairs	Australia	(Sung et al., 2022)
			Trendiness		Digital cameras, washing machines and hairdryers	Not specified	(Mugge & Dahl, 2013)
			Functionality		Women's tops	USA	(Seifert & Chattaraman, 2017)
			Individual difference (age and personality)		iPhone OS icons and Xiaomi smartphones icons	Australia	(Sung et al., 2022)
	Novelty	Emotion	Novelty	2 Studies (5.13%)	Sunglasses, bicycle, stapler, backpack, and sneaker	Taiwan	(WK Hung, 2012)
			Emotion		Lamps, espresso machines, motorcycles, car interiors, USB-sticks, tables	Netherlands	(Bijlevens & Hekkert, 2019)
			Emotion		Pairs	Netherlands	(Post et al., 2016)
			Emotion		Hand vacuums, espresso, pens, toothbrushes	Netherlands	(Van Geert, 2021)
			Emotion		Chairs	Not specified	(Radford & Bloch, 2011a)
Consumer Emotional	8 studies, (20.51%)	Novelty	Emotion	4 Studies (10.26%)	Chairs	Taiwan	(WK Hung, 2012)

Product Category	6 studies (15.38%)	Connectedness	Interest	iPhone OS icons	Not specified	(Sung et al., 2019)
		Aesthetic Pleasure	Visual storytelling	Chairs	USA	Seifert & Chattaraman, 2020
		Typicality and Novelty	the awe and neutral condition	Vase	China	(Yang et al., 2021)
		Novelty	product emotions	cameras, motorcycles, chairs, websites, sunglasses, and sanders	Australia, Netherlands	(J Blijlevens et al., 2017)
Product Appearance	8 studies (20.51%)	Connectedness and autonomy	Different category	Lamps, clocks	Australia	Clementine Thurgood et al., 2014
		Aesthetic Pleasure		Hair dryers	Not specified	(Liu et al., 2020)
		Aesthetic appreciation		Washing machine, vacuum cleaner, smartphone, washing machines and camera	Not specified	(Mugge & Schoormans, 2012a)
		Typicality and novelty		Car and smartphone	German, USA	(Talke et al., 2017)
Eurozone	(Blijlevens, Gemser, et al., 2012)	Connectedness and autonomy	Shape: edges and unique, concave and convex, traditional (square/rectangle)	Sunglass, bicycles, staplers, and sneakers	Netherlands	Blijlevens & Hekkert, 2019
		Aesthetic Pleasure	Color	Cameras, motorcycles, chairs, web designs.	Australia, Netherlands	(Janneke Blijlevens et al., 2014)
		Aesthetic appreciation	Similarity	Sunglass, bicycles, dining tables, espresso, makers, table lamps	Not specified	(Berghman et al., 2016)
		Typicality	Prototype	Taillight and car	India	(Balaji & Singh Bisht, 2020)
Safety and Risk	4 Studies (10.26%)	Typicality and novelty	Shape: angular and triangular	Taillight and car	India	(Balaji & Singh Bisht, 2020)
		Connectedness and autonomy	Color	Chair	Not specified	(Faerber & Carbon, 2013)
		Aesthetic appreciation	Shape: Gaussian curvature KL divergence	Toaster	Europe	(Blijlevens, Carbon, et al., 2012)
		Novelty	Color	Apple juice carton and water bottle		
Aesthetic principles	7 studies (17.94%)	Aesthetic Pleasure	Shape: horizontal and vertical	Automobile	Japan	(Sasaki et al., 2023)
		Typicality and novelty	Balance, proportion, simplicity, unity, symmetry, contrast and harmony	Washing machines and digital cameras	Not specified	(Mugge & Schoormans, 2012a)
		Connectedness and autonomy	conditions of safety and risk	iPhone iOS	Australia	(Sung et al., 2022)
		Aesthetic appreciation	Product Category	Taillight	Not specified	(Luo et al., 2022)
Consumer Evaluation	4 studies (10.26%)	Typicality and novelty	Gestalt principles	Digital camera	Not specified	(Hu et al., 2022)
		Connectedness and autonomy	Unity-in-Variety	Lamps, clocks	Australia	(Clementine Thurgood et al., 2014)
		Aesthetic Pleasure	Most Advanced, Yet Acceptable	sunglasses and bicycles, staplers, and sneakers	Netherlands	(Blijlevens & Hekkert, 2019)
		Novelty	Autonomous, yet connected	bicycles, sunglasses, dining tables, espresso makers, table lamp	Not specified	(Berghman et al., 2016)
Regulatory focus	1 Study (2.56%)	Connectedness and Autonomy	Gestalt principles quantification method	bicycles, sunglasses, dining tables, espresso makers, table lamps;	USA	Berghman & Hekkert, 2017
		Connectedness	Semantic and Symbolic	espresso makers and bicycle	Netherlands	(Loos et al., 2022)
		Aesthetic Pleasure	Product's usability	Topology optimization chairs and beams	Netherlands	(Loos et al., 2022)
		Novelty	Product's product usability	lamps, espresso machines, motorcycles, car interiors, USB-sticks and tables.	Netherlands	(Post et al., 2016)
Consumer Behavior	1 Study (2.56%)	Connectedness	Intention to purchase	car key remote	Netherlands	(Post et al., 2023)
		Aesthetic Pleasure	Different countries	Pants, jackets, and shirts.	USA	(Casalino et al., 2019)
		Novelty		Industrial boilers	Australia, China	(Suhaimi et al., 2022)
		Typicality and novelty		sunglasses and bicycles, staplers, and sneakers.	Netherlands	(Blijlevens & Hekkert, 2019)
Region	1 Study (2.56%)	Connectedness and Autonomy		wheel rims	Not specified	(Jos et al., 2014)
		Connectedness		hand vacuums, espresso, pens, toothbrushes.	Not specified	(Radford & Bloch, 2011b)
		Aesthetic Pleasure		USB flash drive and a mug.	Netherlands	(Cla et al., 2014)
		Novelty		Washing machines and digital cameras.	Not specified	(Mugge & Schoormans, 2012b)
Region	1 Study (2.56%)	Connectedness		cameras, motorcycles, chairs, and websites, sunglasses, and sanders.	Australia, Netherlands	(J Blijlevens et al., 2017)
		Aesthetic Pleasure		sunglasses and bicycles, staplers, and sneakers.	Netherlands	(Blijlevens & Hekkert, 2019)
		Novelty		vase	China	(Yang et al., 2021)
		Typicality and novelty		Cameras, motorcycles, chairs, web designs.	Australia, Netherlands	(Janneke Blijlevens et al., 2014)

Emotion (n = 2 studies, Redford and Bloch^[37] WK Hung^[47]). b) Interest (n = 1 study. c) Visual storytelling (n = 1 study, Seifert and Chattaraman^[39]). The 'emotion, interest and visual storytelling' is indicated as a consumer emotional determinant in six product designs, including hand vacuums, espresso, pens, toothbrushes (Redford and Bloch^[37]), chairs (WK Hung^[47], Seifert and Chattaraman^[39]), iPhone OS icons (Sung^[43]). Thirdly, consumer emotional is highlighted in one study (n = 1 study, studies, 2.56%) and included one code, as the indicators of Connectedness: a) the awe and neutral condition (Yang^[48]). The the awe and neutral condition is indicated as a consumer emotional determinant in one product design, including vase (Yang^[48]). Fourth, consumer emotional is highlighted in one study (n = 1 study, studies, 2.56%) and included one code, as the indicators of aesthetic pleasure: a) product emotions (J Blijlevens et al., 2017). The product emotions is indicated as a consumer emotional determinant in six product designs, including cameras, motorcycles, chairswebsites, sunglasses sanders (J Blijlevens^[21]). These significant codes of consumer emotional refer to the availability of Individual difference (age and personality), Emotion, Interest, Visual storytelling, the awe and neutral condition, product emotions, which is investigated in Perceptual, Cognitive and Social components. Therefore, the consumer emotional determinant of aesthetic preference is a prevalent theme in the literature from twelve product design. It was described as consumers' responses and experiences that predicts the aesthetic preference of product design (Table 4).

Product Category: The scoping review showed that the most common determinant of the reviewed studies (n = 6 studies, 15.38%) have significant results on the 'Product Category' determinant from aesthetic preference of typicality and novelty, connectedness

and autonomy and aesthetic appreciation for determinant is presented in only one common code (Table 4). First, the codes are mentioned in two studies, as the indicators of Typicality and Novelty: a) different category (n = 1 study, Clementine Thurgood^[11]). The different category is indicated as a Product Category determinant in two product designs, including Lamps, clocks (Clementine Thurgood^[11]). Second, the codes are mentioned in three studies (n = 3 studies, 7.69%), as the indicators of novelty: a) different category (n = 3 studies, Liu et al., 2020, Mugge and Schoolman^[34], Talke^[44]). The 'different category' is indicated as a product category determinant in eight product designs, including Hair dryers (Liu^[27]), Washing machine, vacuum cleaner, smart phone, washing machines and camera (Mugge and Schoolman^[34]), Car and smart phone (Talke^[44]). Thirdly, product category is highlighted in one study (n = 1 study, 2.56%), as the indicators of connectedness: a) different category (Blijlevens and Hekkert^[7]). The different category is indicated as a product category determinant in four product designs, including sunglass, bicycles, staplers sneakers (Blijlevens and Hekkert^[7]). Fourth, product category is highlighted in one study (n = 1 study, 2.56%), as the indicators of aesthetic pleasure: a) different category (Berghman^[5]). The different category is indicated as a product category determinant in four product designs, including Cameras, motorcycles, chairs, web designs (Janneke Blijlevens^[22]). Fifth, 'product category' is highlighted in one study (n = 1 study, 2.56%), as the indicators of aesthetic appreciation: a) different category (Berghman^[5]). The 'different product' is indicated as a product category determinant in six product designs, including sunglass, bicycles, dining tables, espresso, makers, table lamps (Berghman^[5]). These significant codes of 'product category' refer to the availability of different product, which is

investigated in Perceptual, Cognitive and Social components. Therefore, the product category determinant of aesthetic preference is a prevalent theme in the literature from fifteen product design. It was described as a specific application of classification that predicts the aesthetic preference of product design (Table 4).

Product Appearance: The scoping review showed that the most common determinant of the reviewed studies (n = 8 studies, 20.51%) have significant results on the 'Product Appearance' determinant from aesthetic preference of unity and variety aesthetic pleasure for determinant is presented in only one eight codes (Table 4). First, the code is mentioned in one study included two codes, as the indicators of Typicality and Novelty: a) Shape: edges and unique, concave convex, traditional (square/rectangle) (n = 1 study, Balaji and Singh Bisht^[2]). b) color (n = 1 study, Balaji and Singh Bisht^[2]). The shape and color are indicated as a Product Appearance determinant in two product designs, including taillight and car (Balaji and Singh Bisht^[2]). Second, the codes are mentioned in three studies (n = 3 studies, 7.69%), as the indicators of typicality included three codes: a) Similarity (n = 1 study, Faerber and Carbon^[15]). b) Prototype (Blijlevens, Carbon^[6]). c) Shape: angular and triangular (Blijlevens, Gemser^[6]). The similarity, prototype and shape is indicated as a product appearance determinant in four product designs, including chair (Faerber and Carbon^[15]), toaster (Blijlevens, Carbon^[6]), apple juice carton and water bottle (Blijlevens, Gemser^[6]). Thirdly, product appearance is highlighted in one study (n = 3 studies, 7.69%), as the indicators of novelty: a) Shape: Gaussian curvature KL divergence (Sasaki^[38]). b) color (Mugge and Schoolman^[34] a, Sung^[42]) The shape and color is indicated as a product appearance determinant in four product design, including automobile (Sasaki^[38]), washing machines and digital cameras (Mugge and Schoormans^[34]) and iPhone iOS (Sung^[42]). Fourth, product appearance is highlighted in one study (n = 2 studies, 5.13%), as the indicators of aesthetic pleasure: a) Shape: horizontal and vertical (Luo^[29]). b) Balance, proportion, simplicity, unity, symmetry, contrast harmony (Hu^[20]). The color and balance, proportion, simplicity, unity, symmetry and contrast are indicated as a product appearance determinant in two product designs, including taillight (Luo^[29]), digital camera (Hu^[20]). These significant codes of 'product appearance' refer to the availability of Shape: edges and unique, concave convex, traditional (square/rectangle), color, similarity, prototype, Shape: angular and triangular, Shape: Gaussian curvature KL divergence, shape: horizontal and vertical, balance, proportion, simplicity, unity, symmetry and contrast, which is investigated in Perceptual, Cognitive and

Social components. Therefore, the product appearance determinant of aesthetic preference is a prevalent theme in the literature from ten product design. It was described as the visual and sensory aspects of a product that predicts the aesthetic preference of product design (Table 4).

Safety and Risk: The scoping review showed that only two studies (n = 4 studies, 10.26%) included only one code have significant results on the 'Safety and Risk' determinant from aesthetic preference of typicality and novelty, connectedness and autonomy aesthetic appreciation for determinant (Table 4). First, safety and risk are mentioned in study (n = 1 study, 2.56%; Clementine Thurgood^[11]), as the indicators of typicality and novelty. The safety and risk are indicated as determinant in two product designs, including Lamps, clocks (Clementine Thurgood^[11]). Second, safety and risk is highlighted in one study (n = 1 study, 2.56%, Blijlevens and Hekkert^[7]), as the indicators of connectedness and autonomy. The 'safety and risk' are indicated as determinant in four product designs, including sunglasses and bicycles, staplers sneakers (Blijlevens and Hekkert^[7]). Thirdly, safety and risk' is highlighted in two studies (n = 2 studies, 5.13%, Berghman^[5] and Hekkert^[4]), as the indicators of aesthetic appreciation. The safety and risk are indicated as determinant in six product designs, including bicycles, sunglasses, dining tables, espresso makers, table lamps: espresso makers and bicycle (Berghman and Hekkert^[4]). The significant code of safety and risk, which is investigated in Perceptual, Cognitive and Social components. Therefore, the safety and risk determinant of aesthetic preference is a prevalent theme in the literature from nine product design. It was described as considerations for potential safety and risk that predicts the aesthetic preference of product design (Table 4).

Aesthetic Principles: The scoping review showed that the most common determinant of the reviewed studies (n = 7 studies, 17.94%) have significant results on the 'Aesthetic principles' determinant from aesthetic preference of unity and variety, typicality and novelty, connectedness and autonomy, aesthetic pleasure for determinant is presented in four codes (Table 4). First, the codes are mentioned in three studies (n = 3 studies, 7.69%), as the indicators of unity and variety: a) Gestalt principles (n = 1 study, Loos et al., 2022). b) Unity-in-Variety (n = 3 study, Loos^[28], Post^[36]). The Gestalt principles and Unity-in-Variety is indicated as an aesthetic principle's determinant in nine product designs, including Topology optimization chairs and beams (Loos^[28]), lamps, espresso machines, motorcycles, car interiors, USB-sticks and tables (Post^[36]) car key remote (Post^[36]). Second, the codes are

mentioned in two studies (n = 2 studies, 5.13%), as the indicators of typicality and novelty: a) Most Advanced, Yet Acceptable (n = 2 studies, Suhaimi^[40]). The Most Advanced, Yet Acceptable is indicated as an aesthetic principle's determinant in four product designs, including Pants, jackets shirts industrial boilers (Suhaimi^[40]). Thirdly, aesthetic principles is highlighted in one study (n = 1 study, 2.56%), as the indicators of connectedness and autonomy: a) Autonomous, yet connected (Blijlevens and Hekkert^[7]). The Autonomous, yet connected is indicated as aesthetic principles determinant in four product design, including sunglass, bicycles, staplers sneakers (Blijlevens and Hekkert^[7]). Fourth, aesthetic principles is highlighted in one study (n = 1 study, 2.56%), as the indicators of aesthetic pleasure: a) Gestalt Principle (Jos^[23]). The Gestalt Principle is indicated as a product category determinant in two product designs, including wheel rims (Jos^[23]). These significant codes of aesthetic principles refer to the availability of Gestalt principles, Unity-in-Variety, Most Advanced, Yet Acceptable, Autonomous, yet connected, which is investigated in Perceptual, Cognitive and Social components. Therefore, the aesthetic principles determinant of aesthetic preference is a prevalent theme in the literature from seventeen product design. It was described as The fundamental criteria guiding the generation and evaluation of beauty that predicts the aesthetic preference of product design (Table 4).

Design Evaluation: The scoping review showed that only two studies (n = 4 studies, 10.26%) have significant results on the Consumer Evaluation determinant from aesthetic preference of novelty, aesthetic pleasure for determinant (Table 4). First, consumer evaluation is mentioned in study and included three codes (n = 3 studies, 7.69%), as the indicators of novelty (Radford and Bloch^[37], Cila^[11], Mugge and Schoormans^[34]): a) Semantic and Symbolic (n = 1 study, Radford and Bloch^[37]). b) Understandability, subtlety, Identifiability (n = 1 study, Cila^[11]). c) Product's usability (n = 1 study, Mugge and Schoormans^[34]). The semantic and symbolic, understandability, subtlety and identifiability product's usability are indicated as a design evaluation determinant in eight product designs, including hand vacuums, espresso, pens, toothbrushes (Radford and Bloch^[37]), USB flash drive and a mug (Cila^[11]), Washing machines and digital cameras (Mugge and Schoormans^[34]). Second, consumer evaluation is highlighted in one study (n = 1 study, 2.56%), as the indicators of aesthetic pleasure. a) Product's usability (n = 1 study, J Blijlevens^[21]). The design evaluation are indicated as determinant in six product designs, including cameras, motorcycles, chairs websites,

sunglasses sanders (J Blijlevens^[21]). The significant codes of 'semantic and symbolic, understandability, subtlety and Identifiability product's usability, which is investigated in Perceptual, Cognitive and Social components. Therefore, the consumer evaluation determinant of aesthetic preference is a prevalent theme in the literature from eleven product design. It was described as consumer product Evaluation that predicts the aesthetic preference of product design (Table 4).

Consumer Behavior: The scoping review showed that only one study (n = 1 study, 2.56%) have significant results on the Consumer Behavior determinant from aesthetic preference of connectedness for determinant (Table 4). Consumer behavior is mentioned in study (n = 1 study, 2.56%, Yang^[48]), as the indicators of Connectedness. a) intention to purchase (Yang^[48]). The consumer behavior are indicated as determinant in one product design, including vase (Yang^[48]). The significant code of consumer behavior, which is investigated in Perceptual, Cognitive and Social components. Therefore, the consumer behavior determinant of aesthetic preference is a theme in the literature from one product design. It was described as considerations for consumer actions or decisions in the face of products that predicts the aesthetic preference of product design (Table 4).

Regulatory Focus: The scoping review showed that only one study (n = 1 study, 2.56%) have significant results on the Regulatory focus determinant from aesthetic preference of connectedness and autonomy for determinant (Table 4). Regulatory focus is mentioned in study and included one code (n = 1 study, 2.56%, Blijlevens and Hekkert^[7]), as the indicators of connectedness and autonomy: a) intention to purchase (Yang^[48]). The regulatory focus is indicated as determinant in four product designs, including sunglasses and bicycles, staplers sneakers (Blijlevens and Hekkert^[7]). The significant code of regulatory focus, which is investigated in Perceptual, Cognitive and Social components. Therefore, the consumer behavior determinant of aesthetic preference is a theme in the literature from four product design. It was described as regulatory focus difference that predicts the aesthetic preference of product design (Table 4).

Region: The scoping review showed that only one study (n = 1 study, 2.56%) have significant results on the Region determinant from aesthetic preference of aesthetic pleasure for determinant (Table 4). Region is mentioned in study and included one code (n = 1 study, 2.56%, Janneke Blijlevens^[22]), as the indicators of aesthetic pleasure: a) different countries. The region is

indicated as determinant in four product designs, including Cameras, motorcycles, chairs, web design (Janneke Bli Fig. 2. Studies selection flowchart jlevens^[17]). The significant code of region, which is investigated in Perceptual, Cognitive and Social components. Therefore, the region determinant of aesthetic preference is a theme in the literature from four product design. It was described as region difference that predicts the aesthetic preference of product design (Table 4).

In line with the suggested framework of The Unified Model of Aesthetics by Hekkert^[17], the current study aimed to scope review the related determinants of safety and risky of aesthetic pleasure, especially in products design. There is a lack of evidence on the comprehensive concept of safety and risky of aesthetic pleasure that includes the overall determinants of Perceptual (unity and variety), Cognitive (typicality and novelty), Social (connectedness and autonomy), especially in products design. The review found that the most common nine predicted indicators of aesthetic pleasure for perceptual (unity and variety), cognitive (typicality and novelty), social (connectedness and autonomy) in product design are design features, followed by consumer emotional, product category, product appearance, safety and risk, consumer behavior, design evaluation, aesthetic principles (unity in variety, most advanced yet acceptable autonomous yet connected), regulatory focus (Fig. 3).

Overall, unity and variety, typicality and novelty, connectedness and autonomy are the essential pillars determining aesthetic preference suggested by the Unified Model of Aesthetics (Hekkert^[17]). However, design features, consumer emotional, product category, product appearance, safety and risk, aesthetic principles, consumer evaluation, regulatory focus, consumer behavior, region, as indicators of aesthetic preference, have little expressiveness in the existing literature. Design features, consumer emotional, product category, product appearance, safety and risk, aesthetic principles, consumer evaluation, regulatory focus, consumer behavior, region are also critical determiners of a aesthetic preference suggested by the Unified Model of Aesthetics (Hekkert^[17]). Recent evidence mentioned that product appearance is directly connected with as a product appearance shape enhances consumers' purchasing preference in product design (Hu^[29], Luo^[29]).

The design features determinant of aesthetic preference is mentioned in about one-third (33.33%) of the reviewed studies is the most common determinant in product design. Design features is described as complexity contribution to aesthetic preference, including the correlate positively with Variety (Post^[35]),

the correlation with novelty (Seifert and Chattaraman^[39], Honda^[19], Van Geert^[46]). Similarly, atypicality is determinants of novelty (Sung^[42]) and aesthetic preference a small positive linear relationship (WK Hung^[47]). However, there is a disagreement about the critical factor of design features, the emotion has inverted U-shaped relationships with aesthetic preference (WK Hung^[47]), product category (Mugge and Dahl^[33]) is also critical to predicting aesthetic preference. Furthermore, the processing fluency (Mayer and Landwehr^[32]), context (Blijlevens, Gemser^[6]) and exposure levels (Landwehr and Wentzel^[24]) are determinants of aesthetic preference for typicality. The interaction of functionality is the critical factor of aesthetic preference for connectedness and autonomy (Blijlevens and Hekkert^[7]). Therefore, different aspects of design features (complexity, atypical, emotional, product category, processing fluency, context exposure levels and functionality) are critical to predicting aesthetic preference in product design.

Consumer emotional is the most common determinant of aesthetic preference in product design (20.51% of selected studies). Consumer emotional is described as both the emotional responses (Radford and Bloch^[37]) and emotional dimension (WK Hung^[47]) in product design. Similarly, consumers' individual difference (Post^[35] Van Geert^[46]) and interest (Sung^[43]) is also a critical determinant of aesthetic preference. In addition, provided the awe and neutral condition (Yang^[48]) is also to increase individuals' choice preferences social connectedness. Surprisingly a study conducted by found that use visual storytelling to communicate associations with the product form is a significant predictor of successful to mitigate the risk of design innovation. Therefore, providing good interest contributes to individuals' emotion status to promote aesthetic preference visual storytelling can effectively mitigate the risk of design innovation.

As a key determinant of aesthetic preference, the product appearance mentioned in many reviewed literatures (20.51%) is described as a shape, prototype, color similarity. The typicality and novelty are included shape such as edges and unique, concave convex, traditional (square/rectangle) (Balaji and Singh Bisht^[2]), angular and triangular ((Blijlevens, Gemser^[6]), Gaussian curvature KL divergence (Sasaki^[38]) color (Balaji and Singh Bisht^[2], Mugge and Schoormans^[34], Sung^[42]). The shape variable of the product appearance of typicality must indicate Prototype (Blijlevens, Carbon^[46]). However, the similarity of product appearance was noted in one study from typicality conducted by Faerber and Carbon^[45]. This result might be due to iPhone's touch screen imitators being highly like the original to significant changes in typicality and liking (Faerber and Carbon^[45]).

The current study also reviewed the product category (15.38%) as critical determinants of aesthetic preference in product design. Overall, the product category refers to a specific application of classification of aesthetic preference. Product from different classification might have different typicality and novelty (Clementine Thurgood^[11], Liu^[27], Mugge and Schoormans^[34], Talke^[44]), Connectedness and autonomy (Blijlevens and Hekkert^[7]), thus having different levels of Aesthetic Pleasure (Janneke Blijlevens^[22]) and Aesthetic appreciation (Berghman^[5]). Although product category is mentioned in only six studies, however, it is the most essential determinant considered in the whole of the the Unified Model of Aesthetics (Hekkert^[17]). In addition, safety and Risk is reviewed in 10.26% of the selected studies as the primary determinant of aesthetic preference in product design. It is defined as conditions of safety and risk of aesthetic preference (Clementine Thurgood^[11], Berghman^[5] Blijlevens and Hekkert^[7]). Similarly, autonomy is moderated by risk not to influence connectedness (Blijlevens and Hekkert^[7]). However, product category is interpreted in the risk for novelty and connectedness as a determinant of aesthetic preference (Berghman and Hekkert^[4]).

As a key determinant of aesthetic preference, the aesthetic principles mentioned in many reviewed literatures (17.94%) is described as a Gestalt principle, Unity-in-Variety, Most Advanced, Yet Acceptable Autonomous, yet connected. The Gestalt principles is included visual perception to increase unity (Loos^[28]), Gestalt principles quantification method (Jos^[23]) such as order divided by complexity, with order quantified in terms of adherence to classical Gestalt principles and complexity (Jos^[23]). The three aspects principles of Unity-in-Variety (Loos^[28], Post^[35], Post^[36]), Most Advanced, Yet Acceptable Suhaimi^[14]), Autonomous, yet connected (Blijlevens and Hekkert^[7]) indicate that the potential impact of aesthetic principles on safety and risk perception, recognize and social components emphasizing a harmonious balance to contribute a sense of safety.

The consumer evaluation of aesthetic preference is mentioned in about a few reviewed studies (10.26%), such as products usability (Mugge and Schoormans^[34], J Blijlevens^[21]) is a determinant to predictor the novelty and aesthetic pleasure of aesthetic preference. However, it is the less represented determinate of aesthetic preference in the reviewed studies. Yet aesthetic preference is defined by various evaluation aspects, such as semantic and symbolic (Radford and Bloch^[37]), understandability, subtletyidentifiability (Cila^[10]). However, few studies (2.56%) indicated the consumer behavior determinants of aesthetic preference in product design compared to those conducted in

consumer evaluation. This may be due to a lack of awareness of the intention to purchase (Yang^[48]) of this determinant in connectedness. Additionally, regulatory focus is only one study reviewed in 2.56% of the selected studies as a determinant of aesthetic preference of connectedness and autonomy in product design. It is defined as regulatory focus fit to operationalize safety and accomplishment (Blijlevens and Hekkert^[7]).

The region of aesthetic preference is mentioned in about only one reviewed study (5.26%), such as product's usability (Janneke Blijlevens^[22]) is a determinant to predictor the aesthetic pleasure of aesthetic preference. However, aesthetic preference is defined by eleven region in thirty-nine studies, such as Eurozone(2.56%, Blijlevens, Gemser^[76]), Europe (2.56%, Blijlevens, Carbon^[6]), Taiwan(2.56%, WK Hung^[47]), Australia(5.12%, Sung^[42], J Blijlevens^[44]), USA(15.38%, Lee and Shin^[25], Seifert and Chattaraman^[39], Talke^[34], Seifert and Chattaraman^[39] and Berghman and Hekkert^[4], China(5.12%, Yang^[48], Suhaimi^[40]), Australia(12.82%, Clementine Thurgood^[42], Janneke Blijlevens^[22], Sung^[42], Suhaimi^[40], J Blijlevens^[27]), Netherlands(20.51%, Janneke Blijlevens^[22], Cila^[10], Post^[36], Blijlevens and Hekkert^[7], J Blijlevens^[21], Van Geert^[46] Loos^[28]), German(2.56%, Talke^[44]), India(2.56%, Balaji and Singh Bisht^[2]), Japan(5.12%, Honda^[19], Sasaki^[41]). Yet, not specified region (35.89%, Mayer and Landwehr^[32], Landwehr and Wentzel^[24], Sung^[42], Mugge and Dahl^[32], Jos^[23], Radford and Bloch^[37], Sung^[43], Liu^[27], Mugge and Schoormans^[34], Mugge and Schoormans^[34], Berghman^[5], Faerber and Carbon^[15], Luo^[29], Hu^[20]). The region is the most represented determinate of aesthetic preference in the reviewed studies.

CONCLUSIONS

The current review provided a broad, comprehensive scoping review over the last 13 years of aesthetic preference determinants of in product design to predict aesthetic preference indicators of perceptual, cognitive social components. The current study showed that literature from aesthetic preference in product design became interested in the aesthetic and the perceptual, cognitive social components of indicators ten years ago. The primary predicted indicator of perceptual component (unity and variety) is design features (complexity and order), consumer emotional (Individual difference (age and personality)), aesthetic principles (Gestalt principles and Unity-in-Variety), represented in a wide range of variables (Fig. 3). The primary predicted indicator of cognitive component (typicality and novelty) is design features (Augmented reality (AR), objective measures, processing fluency, complexity, atypical, design

newness and trendiness), consumer emotional (emotion, interest and visual storytelling), product category (different category), product appearance (shape and color, similarity and prototype), safety and Risk (conditions of safety and risk), aesthetic principles (Most Advanced, Yet Acceptable), consumer evaluation (semantic and symbolic, understandability, subtlety and identifiability, product's usability), represented in a wide range of variables (Fig. 4). The primary predicted indicator of social component (connectedness and autonomy) is design features (functionality), consumer emotional (the awe and neutral condition), product category (different category), safety and Risk (conditions of safety and risk), aesthetic principles (Autonomous, yet connected), regulatory focus (regulatory focus fit), consumer behavior (intention to purchase), represented in a wide range of variables (Figure 5). Various variables of consumer emotional (product emotions), product category (different category), product appearance (balance, proportion, simplicity, unity, symmetry, contrast harmony), aesthetic principles (Gestalt principles and Unity-in-Variety) consumer evaluation (product usability) are also potential indicators of aesthetic preference in aesthetic pleasure. Additionally, the primary predicted indicator of aesthetic appreciation is product category (different category), safety and risk (product category), represented in variables. The primary predicted indicator of aesthetic appreciation is Design features, consumer emotional, product appearance, product category safety and risk are the most important determinants investigated in the aesthetic preference reviewed. The primary predicted indicator of safety and risk is conditions of safety and risk, 'Unity-in-Variety, Most Advanced, Yet Acceptable, Autonomous, yet connected and product category (Fig. 5). Regardless of the instruments, the five determinants provided in the current review could predict aesthetic preference that contributes to aesthetic preference in product design. Therefore, this scoping review contributes to understanding comprehensive the perceptual, cognitive social components, safety and risk indicators of aesthetic preference.

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