Trendiness and Emotion, Two Key Factors for Predicting Aesthetic Preference on Automotive Interior Form Design Among Chinese Consumers

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Abstract. Semantics reflects what people perceive in product appearance. Previous studies demonstrate that user's description of product appearance can be categorized into three fundamental semantic dimensions (trendiness, complexity, and emotion). Each dimension formed a linear relationship with novelty, which has been proved to be one of the determining factors in aesthetic preference. Although automotive interior design is subordinate to product design, it's unique since interior design is more complicated, more time costing, and growth cycle of interior designers is much longer. In this study, we collected a large number of automotive interior photos, and extracted representative ones from each car category (sedan, SUV, pick-up, and mini-car) by sorting and clustering. Then we conducted a research on Chinese consumers, to explore the relationship between three semantic dimensions and aesthetic preference on interior form design, and built a mathematical expression for them with stepwise regression analysis. The result shows that: for Chinese consumers' aesthetic preference on automotive interior form design, both trendiness and emotion have a significant impact on aesthetic preference; while the impact of complexity is extremely small. Hence, in order to improve design efficiency, designers should take trendiness and emotion factors into account during new aesthetic generation and design revision period.

Keywords: Automotive interior design · Aesthetic preference
Aesthetic experience

1 Introduction

As a typical industrial product, the appearance of automotive design is the key to success, by increasing the competitive advantage in market. For consumers, automotive interior is not only a space for driving but also an agent for consumers to express their identities, such as status, aesthetic tastes and hobbies. Realizing the fact that Chinese consumers

seem to have a special aesthetic standard on automotive design, many auto companies often launch special versions of new products for Chinese market.

Product appearance is of significant meaning to consumers, usually, customers pay most attention to design and aesthetics when they make decision on purchasing. People often judge products according to the initial visual impression. Aesthetic preference reflects individuals' cognition and judgment to products' visual elements. Due to the diversity of its design elements, automotive interior design has high requirements for the background knowledge, design skills and experience on designers. Therefore, to create products that are more desirable to consumers, car designers need to understand which factors influence the consumer's aesthetic experience on automotive interior design, and improve the effectiveness and credibility of design.

2　The Present Research on Aesthetic Preference

Aesthetic refers to the visual form and sensory experience of objects that associated with structure, harmony, rules of style and sense of beauty [17]. By visual communication, aesthetics decides individual's perception on objective things, and further, influences individual's behavior. Vision is the most informative one in five senses, which has the hugest impact on consumers, compared with other senses. Products with higher visual aesthetics, in general, can achieve higher expressiveness, enlightenment and cheerfulness. The generation and perception of visual aesthetics are formed through human evolution in thousands of years prehistoric [23]. It's a way of communication before the formation of language [16]. Consumers get aesthetic experience from aesthetically appealing product designs. Aesthetic experience treated as a high-level cognitive process, mingled with cognitive, imagination, and feelings interact [17].

2.1　Aesthetic Experience and Neuroscience

Aesthetic experience is particularly interesting because of their hedonic properties and the possibility to provide self-rewarding cognitive operations [15]. The research in neuroscience has shown that visual stimuli with aesthetics are associated with higher reward values in the brain [19]. Several researches have shown that understanding of artwork results in an activation of the rewarding centers in the brain, and this activation will further influence individuals' preference, judgment and decision-making [6]. If a product has higher aesthetic value, it's more likely to stimulate the reward system in the brain, and receive higher preferences and appreciation as a consequence [21].

2.2　Visual Information Processing of Aesthetic Preference

To explain visual information processing in aesthetic appreciation, Leder proposed the model of aesthetic experience [14]. According to Leder's theory (Fig. 1), aesthetic experience is continuing cognitive process, accompanied by up growing emotional state that triggers aesthetic emotion, and this continues consists of five stages: perceptual analysis, internal memory integration, explicit classification, cognitive mastering and

evaluation, affective and emotional processing. In the prior two stages, visual information processing is a spontaneous process, which proceeds quickly, unconsciously and without effort. In other words, in these two stages, visual information processing is subliminal and automatic, individuals are not able to manipulate it by will.
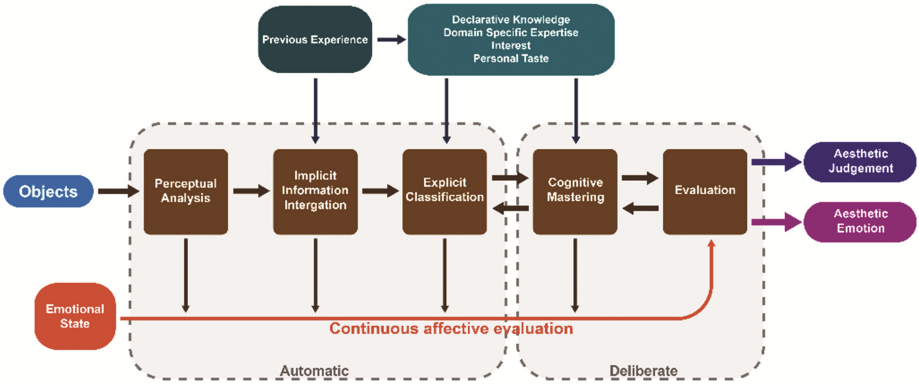

Fig. 1. Model of aesthetic experience.

Aesthetic preference is primly determined by the output of these two stages. Perceptual analysis mainly refers to occipital visual processing for basic image information, including complexity, color, symmetry, grouping, and order of images, can have an effect on aesthetic experience [14]. The result of implicit memory integration does not have to become conscious in order to affect aesthetic processing. In this stage, familiarity and typicality are included. By 'mere-exposure' paradigm, some studies have shown that familiarity increases the aesthetic experience for a stimulus [12]. Typicality is defined as an attribute of products that deals with the extent to which the product is representative in a product category, which has been proved to affect individuals' aesthetic experience.

To summarize, factors that affect aesthetic preferences can be classified into four groups: the basic image elements, the underlying visual information including color, shape and etc.; complexity, which is related with number and variety of basic image elements; rules of form, the general summary or conclusion of forms, including symmetry, equilibrium, proportions, rhythm and etc.; background elements, based on individuals' past experiences, such as novelty, familiarity and typicality.

2.3   Aesthetic Preference and Product Design

Novelty is an issue that has always been discussed in studies on aesthetic preference of product design. Berlyne firstly proposed the theoretical model of inverted U-curve to explain the relationship between novelty and product aesthetic preference [1]. His model argues that products with medium level novelty are preferred over both extremely typical and extremely novel objects. Hekkert measured the effect of novelty and typicality separately, finding that novelty and typicality have large negative correlations; his study

also shows that novelty and typicality are jointly and equally effective in explaining the aesthetic preference on consumer products, but each of them tend to inhibit the effect of the other one [9]. Hung and Chen verified the inverted U-curve relationship between novelty and aesthetic preference on products, and proposed three dimensions to influence the novelty of product design, trendiness (traditional-trendy), emotion (emotional-rational) and complexity (simple-complex). The three dimensions all have a linear correlation with novelty, and they all contribute to the perception of novelty [11].

3   Automotive Interior Design

Automotive interior is the most complicated part in the automotive design, with the so many parts related. Tasks of interior design is about form, texture, color, and material. Since exterior design is often dominated by technical constraints such as the aerodynamics, interior design often allows designers to use more individual and aesthetically justified designs [13]. The perceived quality of automotive interior is influenced by not only user's background information factor but also brand factor [5]. Leder's investigation on attractiveness and interior characteristics indicate that interior attractiveness ratings are particularly affected by curvature and innovativeness, and curved and non-innovative designs were generally preferred [13]. In addition, research on unity-in-variety indicated that, although both unity and variety can be used on prediction for aesthetic appreciation of interior design, unity is much more influential than variety, and automotive design students attribute more appreciation to unity [20].

Car is a classic industrial design product, and users' cognition on cars are highly emotional. The style of the automotive interior reflects brand idea integrated with designers' intention. As for the composition of interior, automotive interior is made up of a variety of parts, including steering wheel, dashboard, rear-view mirror, change gear, multi-media equipment, air-conditioning and wind gap [22]. Design of components are
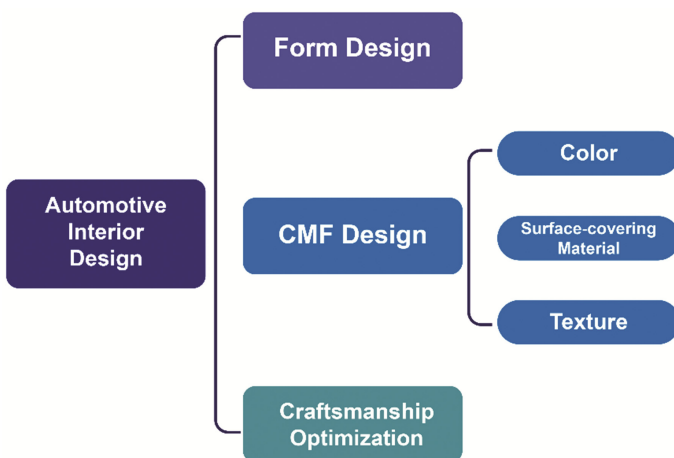

Fig. 2. Tasks in automotive interior design

often emphasized the importance of focusing on unity, as the whole must predominate over the parts, and components must be structured into a coherent interior design [20]. Task of interior design consists of form design (Fig. 2), CMF design (including color design, surface-covering material design and texture design) and craftsmanship optimization [8]. The interior design process always starts from a theme defining, accompanied by conceptual design, scale model, digital models, and reverse engineering, ends when real model generated. To summarize, although interior design of the car is subordinate to industrial design, the interior design is unique because of high complexity, the variety of components and long design term.

4   Study on Aesthetic Preference on Interior Form

Statements above revealed the fact that there's a significant difference between automotive interior design and consumer products design. Hence, the aim of this study was to assess whether influential factors for aesthetic preference on consumer products, would be applicable for predicting aesthetic preference on automotive interior. Since color design and surface-covering material design are all attached to interior form, in this study, we mainly investigate the effect on form.

We adopted the theory proposed by Hung and Chen that trendiness, emotion, and complexity are three factors for aesthetic preference on products design [11]. They are also semantic dimensions that suitable for describing the emotional response to products [10]. We should make a brief review of three factors before carrying out research.

Trendiness factor, also known as modern sense, contemporary, avant-garde, and young [7]. Trendy, which refers to in a particular time span, to what extent the style is popular. As a result, trendiness is influenced by changing of times. For product design, trendiness refers to an attribute of product designs that deals with the degree to which the product design follows the up-to-date styles and fashion in the market [4].

Complexity factor means that the category, component, factor, and concept are diverse, and there is an interconnected interplay of relationships which is difficult to analyze. The complexity of the product design is mainly related to the number of elements and the unity in design [10]. Complexity is opposite to simplicity, which has been proved to be another aspect of user's cognition on product appearance. By Leder's research, complexity is confirmed to affect the user's aesthetic preference on automotive interior aesthetic appreciation [13].

Emotion factor could be explained by some bipolar adjectives such as, emotional-rational, soft–hard, feminine–masculine. By analyzing the appearance characteristics, Hsiao and Chen found that products with high emotion values are likely to have curved feature lines, plump surfaces, and organic forms; whereas products with low emotion values tend to have straight lines, flat surfaces, and geometric forms [10]. Thus, emotion factor may have a close relationship with the curvature in aesthetic preferences [11]. As a result, the emotional factor of product's aesthetic preference is mainly affected by shape and form of the basic visual elements. Blijlevens created a series of stimuli varying from angular to rounded shapes and found that aesthetic responses to this series of "angular curved" variations exhibited an inverted-U-shaped relationship [2].

4.1   Measurements

A 5-point semantic-differential scales were used for measurement on aesthetic preference on automotive interior form, trendiness, emotion, and complexity. The adjective beautiful was selected as rating scale for aesthetic preference on automotive interior form; and for investigating the effects of trendiness, emotion and complexity separately, three additional adjectives were introduced as rating scales, modern for trendiness, emotional for emotion and complex for complexity.

4.2   Stimuli

The aim of present research was to explore how trendiness, complexity, and emotion influence the aesthetic preferences of automotive interior form. Thus, stimulus should cover a wider range, and be as representative as possible, rather than be specific to a particular brand or a type of car. The above considerations are based on established fact: cars of the same brand may have family gene features, and cars of the same type may have some type features. For example, every Hyundai car has fluid sculptural exterior surface, and SUV cars have strong and powerful fender. These family gene features and type features may decrease the variety of stimulus.

Many consumers would view automotive interior on Internet before buying cars [18], which suggested that consumers form their first impressions on automotive interiors mainly by photos on websites and smartphone Apps, rather than real cars on road or in sales centers. Therefore, we decided to take photos as stimulus, as this will simulate the condition that they get know of new cars mostly.

The research collected 39 photos of automotive interior from Autohome and NetCar-Show on website. To ensure the representativeness of every sample, and improve the efficiency of questionnaire, samples were refined by two steps. Step one, cars launched between 2005 and 2017 was selected. This mainly because of the time span of 12 years would ensure there is noticeable difference in trendiness, as automakers launch new generation of design, on average, every 4 years. As the service time of cars is 15 years in common, cars launched after 2005 would be able to avoid unfamiliarity of stimulus to participants. The second step, in order to ensure that the samples were differential in emotion and complexity factors, photos were sorted by two Ph.D. students that have studied in automotive design. As for emotion factor, all interior photos are classified into three groups according to the curvature of interior feature line, and plumpness of surface; as for complexity factor, interior photos are classified into three groups, namely "high complexity", "medium complexity" and "low complexity". Then, we chose at least two photos from each group as stimulus.

Finally, eight representative interior photos were selected as stimulus, including 3 concept cars, and 5 mass production cars (including sedan, mini car, SUV, and pickup). To remove the irrelevant variable, such as brand, background of interior photos and angle of camera, research has particular requirement on stimuli photos: the size of photos is 1900 * 1200 pixels, 300 dpi; the background of automotive interior is white; brand logo, images in multi-media devices, name, and other brand identities are removed from stimuli photos (Fig. 3).

Fig. 3. Photos of 8 stimulus.

4.3   Subjects

The subjects were 75 participants, they are postgraduates and undergraduate students from Hunan University, in China. Therefore, the results only reflect the cognitive status and aesthetic preference of a group of Chinese people who are young and well educated.

4.4   Procedure

The research is a two-step questionnaire.

Step one, subjects were required to watch the 8 stimuli photos, and rate the appearance of every stimuli according to how beautiful its form is, the score of every stimulus reflected participants' aesthetic preference. As mentioned before, interior design consists of three parts, form, color and material, and each part works independently. Thus, to ensure participants' aesthetic preferences for form would not be influenced by color and texture, we created special versions of stimuli photos. For all stimuli photos in step one, color was removed, luminosity values was preserved and texture was erased by Gaussian Blur in Photoshop. Step two, subjects were asked to evaluate the three factors that influenced the aesthetic preference on automotive interior: trendiness, complexity, and emotion.

4.5   Result

The average scores of aesthetic preference rating, complexity, trendiness and emotion for eight stimulus are shown in Table 1.

Table 1. The average scores of the measurements

	Stimuli 1	Stimuli 2	Stimuli 3	Stimuli 4	Stimuli 5	Stimuli 6	Stimuli 7	Stimuli 8
Aesthetic preference	2.42	2.95	3.58	2.87	2.98	2.38	3.11	4.02
Complexity	3.60	2.89	2.42	3.62	2.92	2.67	2.94	2.98
Emotion	3.84	2.42	2.91	2.22	3.36	2.67	4.31	2.44
Trendiness	2.62	2.95	4.07	2.76	3.20	2.07	3.95	4.05

4.6   Exploratory Analysis

The aim of present study was to explore how three factors (trendiness, complexity, and emotion) influence Chinese consumers' aesthetic preferences on automotive interior form. We added the average scores of trendiness, complexity and emotion for eight stimulus as three variables, and conducted a stepwise linear regression analysis.

At step one of analysis, we only introduced trendiness factor as independent variable to exam the assumption that the aesthetic preference on automotive interior would be affected by trendiness factor. The results supported our hypothesis, indicating that a significant proportion of the variance in aesthetic preference on automotive interior was explained by trendiness ($\beta = 0.650$, $p < 0.01$); $R^2 = 0.749$, $F = 23.193$, $p < 0.01$.

At step two of analysis, we added emotion factor as an independent variable to examine whether aesthetic preference on automotive interior would also be influenced by the curvature of feature line and plumpness of surface. Result suggested that more proportion of the variance in aesthetic preference on automotive interior was explained by not only trendiness ($\beta = 0.713$, $p = <0.01$) but also emotion ($\beta = -0.307$, $p < 0.01$); $R^2 = 0.965$, $F = 68.681$, $p < 0.01$. Two factors account for 96.5% of the variance, which suggests that we could stop adding new variable into regression analysis, but we continue the third step to test the impact of complexity factor.

At step three of analysis, when complexity factor was introduced into multiple regression analysis, explanatory power of both trendiness factor and emotion factor decrease very slightly. The result of analysis showed when complexity factor was added, the explanation didn't increase, which indicate that aesthetic preference on automotive interior is significantly influenced by trendiness factor ($\beta = 0.718$, $p = <0.01$) and emotion factor ($\beta = -0.309$, $p < 0.05$), while complexity factor ($\beta = 0.025$, $p > 0.05$) has no significant effect on aesthetic preference on automotive interior; $R^2 = 0.965$, $F = 36.956$, $p < 0.01$.

4.7   Conclusion

Thus, complexity factor was eliminated, and we adopt the result in step two of stepwise regression analysis, and build following regression formula ($R^2 = 0.965$, $F = 68.681$, $p < 0.01$):

$$aesthetic\ preference\ = 1.677 + 0.713 * (trendiness\ factor) + (-0.307) * (emotion\ factor)$$

Two factors account for 96.5% of the variance in aesthetic preference on automotive interior, which indicate that complexity factor is not applicable for predicting aesthetic preference on automotive interior form. Therefore, trendiness factor, and emotion factor was regarded as predictor variables. In particular, regression coefficient of trendiness factor is 0.713, which suggests that trendiness has a positive linear relationship with aesthetic preference on interior form, in other words, more trendy more preferred. However, regression coefficient of emotion factor is -0.307, which shows a negative linear relationship between emotion factor and aesthetic preference. According to the relationship between product semantics and feature that proposed by Hsiao and Chen [10], we may conclude that interior with more curved feature line and plumper surface

will be less preferred. Partial regression analysis for both trendiness factor and emotion factor shows significant linear relation (Fig. 4).
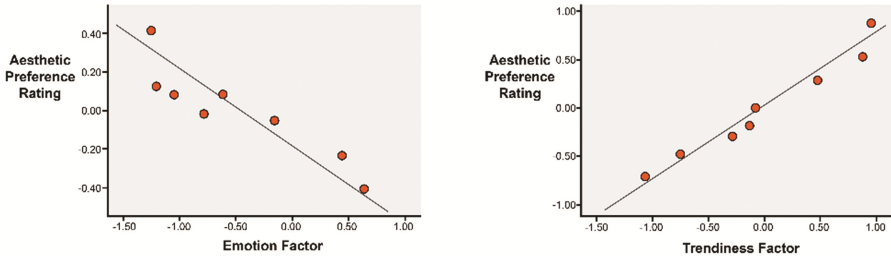

Fig. 4. Partial regression analysis for trendiness factor and emotion factor.

5   Discussion

In this research, based on literature review, we presented brief statement of the content of visual information processing in every stage of the aesthetic experience, and summary of visual factors that affects individuals' aesthetic preference in general, and then described three factors for aesthetic preference on common consumer products as well as differences between automotive interior design and product design.

We conducted a test among Chinese consumers to evaluate how automotive interior form is preferred, and assessed every automotive interior in three dimensions: trendiness, complexity, and emotion, which have been proved to be three influential factor for aesthetic preference on product design. Also, we took a stepwise linear regression analysis to explore the mathematical relationship between them aesthetic preference on automotive interior form and three influential factors. Analysis of results provided evidence for our assumption that influential factors for aesthetic preference on product design are partly applicable for predicting aesthetic preference on automotive interior, and explanation of every factor differentiates from each other. Complexity factor has a minimal impact on aesthetic preferences of automotive interior, which coincide with Leder's experimental results [13]. Both trendiness factor and emotion factor have significant influence on preference of automotive interior prediction. But, compared with trendiness factor, emotion factor explained a smaller proportion of the variance in aesthetic preference on automotive interior. This finding is not surprising, as trendiness often show up as the most important factor affecting consumer perception of product appearance [3, 10, 11].

Mastering the key impact factors of the aesthetic preference on interior design can provide practical reference for developing automotive interior for Chinese market. In various stages of interior design project, such as theme defining, conceptual design, and design revision, design work are always based on the mapping relationship between semantics and characteristics. Both emotion factor and trendiness factor link to particular type of characteristics. Thus, in theme defining stage, they are assisted to theme words filtering and sorting; in aesthetic generation stage, they have guidance function imagery

selection; in the stage of design evaluation and revision, they can provide evaluation index and weight for a structured evaluation system.

6   Limitation

Although it has been proved that trendiness is the most influential factor in the aesthetic preference for automotive interior form, the definition and quantization of trendiness factor are among the most difficult tasks in design. One possible reason may be that essence of trendiness changes when times change. Another reason may due to the complicacy of automotive interior design. As mentioned before, interior design is a complicated task, thus, trendiness may be affected by some non-form factors such as material, color, texture and light. Even if stimuli photos being decolorized and texture has been erased, the interior form factor can't be totally separated from non-form factors. So, in the study about aesthetic preference on automotive interior form factor, being disturbed by non-form factors is inevitable.

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