Research on the Design of Wedding Supplies from the Perspective of Aesthetic Preferences

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Abstract. In the context of the personalized and diversified modern wedding transformation, the design of wedding supplies based on aesthetic preferences is of great significance. This study combines the Kano model, entropy theory, and stepwise linear regression to construct a design process for wedding supplies based on aesthetic preferences. Firstly, the design requirements are evaluated based on the Kano model to determine the target for designing products with attractive features. Secondly, entropy theory is applied to obtain the weights of aesthetic preference imagery and the comprehensive evaluation values of aesthetic preferences for each research sample. Then, using stepwise linear regression, the relationship between aesthetic preferences and sample design elements is established to guide design practice. Finally, taking the Chinese character "囍" (symbolizing happiness) as an example, the design schemes are generated to demonstrate the feasibility of the entire research process.

Keywords: Aesthetic preferences; Wedding accessory design; Kano model; Stepwise linear regression

1. Introduction

As one of the four major joys in life, weddings are usually well-prepared to leave beautiful memories for the newlyweds. The wedding supplies, which are indispensable in wedding celebrations, represent the sincerity of the couples and signify their respect and importance for the wedding itself and the guests. Although there is a wide variety of such products available in the market, there are relatively few products that truly reflect traditional wedding customs and cultural characteristics. They tend to be monotonous and lack aesthetic preferences.

Aesthetic preference, as an important aspect of aesthetic research, has been studied earlier and more extensively overseas. Based on existing research on the perception of product design, Hung et al.[1] explored the impact of novelty on consumer perception from the dimensions of fashionability, complexity, and emotional appeal. Kaoruno [2] demonstrated through experiments the relationship between the overall "perceptual structure" and aesthetic preferences, and studied the influence of increased graphic complexity on aesthetic preferences. Zhu et al. [3], based on the research process of Kansei engineering, investigated consumers' aesthetic preferences for design styles and elements in the medical field interface design. Zhang [4] used the Kansei engineering method to explore the design elements in automobile interior design that meet users' aesthetic preferences.

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As one of the objects of cultural and creative product design, wedding supplies need to follow certain design principles and theoretical knowledge, integrating consumer aesthetic preferences, artistic value, practicality, and creativity, while creating emotional resonance. Therefore, this study starts from the spiritual needs of consumers and takes the traditional auspicious pattern "Dragon and Phoenix" as the basis. It employs a combination of qualitative and quantitative methods to establish an association model between the design elements of wedding supplies and aesthetic preferences to explore design principles and methods that can meet users' aesthetic preferences. This study aims to generate design strategies and provide more scientifically guided approaches for wedding supplies design under aesthetic preferences, which has theoretical significance.

2. Research Process

2.1 Determining the design requirements of wedding supplies based on the Kano model

The Kano model, as one of the tools for classifying and ranking data, is used for evaluating satisfaction with requirements, reflecting the non-linear relationship between requirements and satisfaction. It categorizes requirements into five types, including attractive requirements, indifferent requirements, expected requirements, must-be requirements, and reverse requirements.

According to the Kano Model Attribute Judgment Matrix [5], the initial design requirements are classified into different categories. The attributes are represented by A (Attractive), O (One-dimensional), M (Must-be), I (Indifferent), and R (Reverse), while Q is used to indicate invalid questionnaires.

To facilitate the classification of requirements and determine their corresponding attributes, the Relative Satisfaction Coefficient calculation method proposed by Berger is used for judgment. The specific process is as follows:

When the requirement is provided:

$$Better\left(S_i\right)=\frac{N_A+N_O}{N_A+N_O+N_M+N_I} \tag{1}$$

When the requirement is not provided:

$$Worse\left(D_i\right)=-1\times\frac{N_M+N_O}{N_A+N_O+N_M+N_I} \tag{2}$$

Where N_A, N_O, N_M and NI represent the quantities of A, O, M, and I in the statistical results, respectively.

Based on the judgment results, the classification of requirement attributes is completed, which helps determine the categories for wedding supplies design.

2.2 Analysis of the association between aesthetic preferences and design elements of wedding supplies using entropy and linear regression

The association between aesthetic preferences and design elements is an important pathway for design generation based on aesthetic preferences, as well as a crucial step in guiding design practice.

2.2.1 Decomposition of sample design elements

In the process of designing aesthetic preferences for a product, it is necessary to analyze its form first, complete the deconstruction of design elements, and analyze and describe the corresponding elements. This study will use form analysis [6] to decompose the design elements of the wedding supplies research samples, laying the foundation for subsequent sample imagery evaluations and design practices.

2.2.2 Comprehensive evaluation of aesthetic imagery based on entropy theory

Entropy [7] was proposed by the German physicist Clausius in 1865 and is primarily used to describe the state of a system. With the expansion and application of the concept, other concepts such as information entropy and negentropy have also emerged. Information entropy is mainly used to measure the stability of a system. In the field of product design, Su et al. [8] established a modeling imagery evaluation model based on information entropy theory, with the composite cognitive space of users, designers, and engineers as the core, and used it to guide the selection of typical product case libraries.

Based on the aesthetic imagery evaluation values of the research samples, data will be processed using entropy theory to obtain the weights of each imagery, thereby determining the comprehensive aesthetic imagery evaluation values for each sample.

Generally, the calculation method for sample imagery evaluation using entropy representation is as follows:

$$I_j = -\mathrm{k}\sum_{i=1}^{m} p_{ij} \ln p_{ij} \tag{3}$$

Where I_j rpresents the entropy value of the imagery, P_{ij} represents the probability of the j-th imagery for the i-th sample,$0 \le P_{ij} \le 1$, i represents the research sample i=1,2，…，m；j represents the imagery j=1,2，…，q；and k represents a constant, $\mathrm{k} = 1/\ln m$.

The aesthetic imagery probabilities are obtained through data normalization. Based on formula (4), the entropy value I_j of the j-th imagery can be obtained. From this, the weight value w_j of each imagery in this study can be determined.

$$w_j = \frac{1 - I_j}{\sum_{j=1}^{n} (1 - I_j)} \tag{4}$$

Based on this, the comprehensive aesthetic imagery evaluation value T_i for each research sample can be obtained as:

$$T_i = \sum_{j=1}^{q} w_j T'_{ij} \tag{5}$$

Where T'_{ij} represents the average evaluation value of the *j-th* aesthetic imagery vocabulary for the *i-th* sample.

2.2.3 Evaluation of the relationship between design elements and aesthetic preferences based on stepwise regression analysis

Combining the obtained design element classification table and comprehensive imagery evaluation values, a relationship model between wedding supplies and aesthetic preferences is established using the stepwise regression analysis method. In this process, "0" and "1" are determined as dummy variables [9], representing the "absence" and "presence" of the elements respectively. Based on this transformation, the design element coding table of the samples is created using {0, 1} assignment [10].

Taking the design elements of the samples as independent variables and the comprehensive evaluation values of aesthetic preferences as the dependent variable, a multiple linear regression model is established to map the relationship between each design element and aesthetic preference. Thus, the regression model can be represented as:

$$Y = a + b_1 x_1 + b_2 x_2 + \cdots + b_n x_n \tag{6}$$

Where $\{x_1, x_2, \cdots, x_n\}$ is the independent variable, Y is the dependent variable, a is the constant term, $\{b_1, b_2, \cdots, b_n\}$ is the partial correlation coefficient. Meanwhile, there exists a linear correlation between the independent variables and the dependent variable.

Stepwise linear regression analysis is performed using SPSS. The goal is to obtain the optimal equation and ensure that only the independent variables with a significant impact on the dependent variable are included in the equation [11]. The analysis results are then used to guide wedding supplies design.

3. Design Practice

3.1 Wedding Product Design Requirement Acquisition

According to the requirement acquisition process, an initial requirement survey was conducted using an online questionnaire. A specific target group was selected, and after removing invalid questionnaires, a total of 42 valid questionnaires were obtained. After analyzing the results, a total of 32 preliminary requirements were identified and summarized, including bedding, pyjamas, flip-flops, road guide, and so on.

The obtained 32 requirements are designed into a Kano questionnaire. People with experience in wedding events from different age groups and professional fields are invited to fill out the questionnaire, and the results are summarized.

A total of 78 participants took part in the questionnaire, and after preliminary data analysis, 23 invalid questionnaires were excluded, leaving 55 valid questionnaires. To ensure the reliability

of the evaluation results, the feasibility analysis is conducted using Cronbach's alpha coefficient on the valid questionnaires. The closer the coefficient is to 1, the better the result reliability. The input of the survey data into SPSS yields reliability coefficients of 0.950 for the positive direction and 0.949 for the negative direction. This indicates good consistency in the questionnaire results and high data reliability, which can be used for subsequent content analysis and decision-making.

Based on the Kano model attribute determination matrix, the questionnaire results are analyzed and summarized, as shown in Table 1.

Table 1. Statistics on the results of the research questionnaire

No.	Requirements	A	O	M	I	R	Q	Sum
T_1	bedding	4	6	11	34	0	0	55
T_2	pyjamas	3	3	0	47	2	0	55
T_3	flip-flops	3	3	0	41	8	0	55
…	…	…	…	…	…	…	…	…
T_{31}	corsage	0	6	2	46	1	0	55
T_{32}	road guide	2	2	3	48	0	0	55

Using equations (1) and (2), the satisfaction coefficients for each design requirement are calculated to determine the attribute of each requirement, as shown in Table 2.

Table 2. Better-Worse coefficient results by demand

No.	Requirements	Kano Properties	Absolute value of Worse coefficient	Better Factor
T_1	Bedding	Required Attributes	30.91%	18.18%
T_2	Sleepwear	Undifferentiated Attributes	5.66%	11.32%
T_3	Slippers	Undifferentiated Attributes	6.38%	12.77%
…	…	…	…	…
T_{31}	Corsages	No Difference Attribute	14.81%	11.11%
T_{32}	Road guide	No Difference Attribute	9.09%	7.27%
		Average	16.27%	20.01%

According to the analysis of the Kano model, the requirements are summarized as shown in Table 3.

Table 3. Requirements for wedding supplies

form	A	O	M
requirement item	T_{16}, T_{18}	T_{23}, T_{25}, T_{26}, T_{28}, T_{30}	T_1, T_{29}

Combining the design requirement results from Table 3, the case study will focus on the design of a wedding "囍" (a decorative Chinese character symbolizing happiness) product with attractive attributes to illustrate the feasibility of the research process.

3.2 Wedding Product Design Practice

3.2.1 Determination of the Wedding "囍" Product Research Samples

More than 120 initial samples of wedding "囍" products were collected from various sources such as the market, internet, and journals. Through organizing, screening, expert discussions, and the use of the KJ method, a final selection of 49 representative samples was made to form a research sample library, as shown in Figure 1.

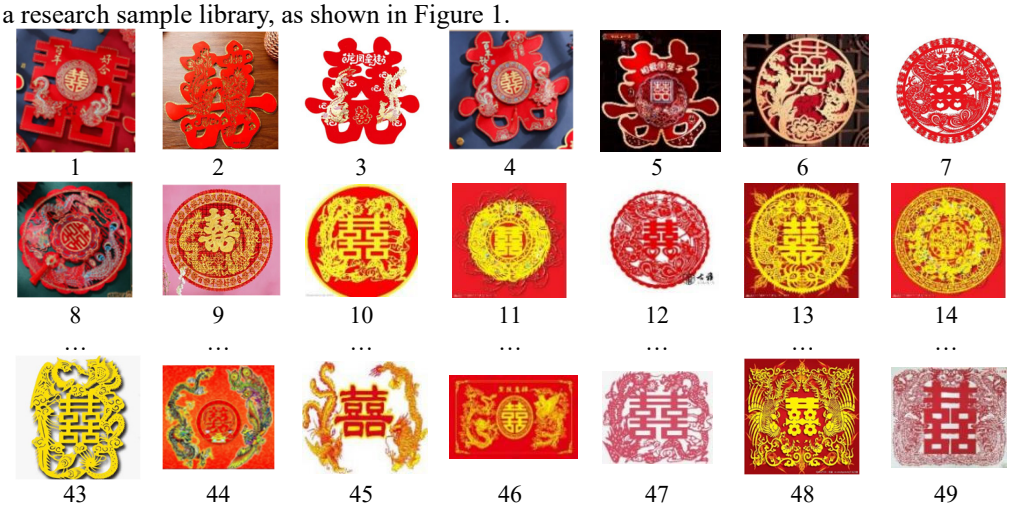

Fig. 1 Wedding "囍"Representative Research Sample Database

3.2.2 Decomposition of the Design Elements of the "囍" Samples

Based on the aesthetic and functional characteristics of the "囍" ,the samples are analyzed into 11 design elements, including the main form, color types, and pattern distribution forms. The design element categories are summarized in Table 4 based on the analysis of the samples.

Table 4. Wedding "囍" Design Elements Table

design element	class			
Product body form (A)	Literal (A1)	Round (A2)	Heart (A3)	Shaped (A4)
Product body color (B)	Red (B1)	Gold (B2)	Mixed Multicolor (B3)	
Product color type (C)	Class I (C1)	Two types (C2)	Three types (C3)	Category III and above (C4)
Product color saturation (D)	High (D1)	Low (D2)		
Dragon and phoenix pattern color (E)	Red (E1)	Gold (E2)	Mixed Multicolor (E3)	
Pattern distribution form (F)	Surround (F1)	Covered with it (F2)		
Dragon head position (G)	Off Top (G1)	Centered (G 2)	Offset Lower (G 3)	

Position of the phoenix head (H)	Off Top (H1)	Centered (H2)	Skewed Down (H3)	
Dynamic modeling of the dragon body (I)	Vertical (I1)	Horizontal (I2)	Left Skewed (I3)	Right oblique (I4)
Dynamic modeling of the phoenix body (J)	Vertical (J1)	Horizontal (J2)	Left-skewed (J3)	Right oblique (J4)
Distance between dragon and phoenix (K)	Offset (K1)	Offset (K2)		

3.2.3 Acquisition of Aesthetic Preference Imagery

Image words are the externalization of aesthetic preferences and serve as the basis for evaluating the samples in the subsequent design practice. By using the KJ method and mean method, 48 aesthetic image vocabulary are screened and statistically analyzed. Adjectives with a selection frequency exceeding three-quarters of the total number of participants are chosen as aesthetic preference imagery words. For example, “festive” (7), “fashionable” (6), and “romantic” (8).

3.2.4 Evaluation of the Sample Imagery

Combining the research samples and the aesthetic preference imagery words, an evaluation questionnaire is established using a five-point Likert scale. A total of 50 consumers are invited to participate in the evaluation process, including 20 graduate students in design, 25 couples preparing for weddings, and 5 ordinary consumers. After excluding 3 invalid questionnaires, the results are processed using the mean method, and the imagery evaluation values of the “大囍字” research samples are obtained.

3.2.5 Obtaining the Composite Evaluation Values of Imagery based on the Entropy Theory

Based on the previous research process, the weights of the imagery words “festive,” “fashionable,” and “romantic” are calculated as 0.1396, 0.4241, and 0.4363, respectively, using the entropy theory. According to Equation (5), the composite evaluation values of the imagery for each research sample are obtained as: T={3.936, 3.328, 1.842, …, 2.055, 2.762}.

3.2.6 Evaluation of the Relationship between Design Elements and Aesthetic Preferences based on Stepwise Regression Analysis

The “囍” samples are encoded using a {0, 1} assignment to obtain the design element encoding result for the 49 samples.

Using the wedding “囍” sample design elements as independent variables and the composite evaluation values of aesthetic preferences as the dependent variable, stepwise linear regression analysis is conducted using SPSS to establish a multiple linear regression model and map the relationship between design elements and aesthetic preferences. Based on the design element encoding table and the composite evaluation results of aesthetic preferences, the specific regression equation is obtained:

$$y = 2.355 + 1.162C_3 + 1.049C_1 - 0.580A_4 + 0.996G_2 + 0.943A_1 \quad (7)$$

The regression model shows an F-value of 11.606, and the significance value of the regression test is sig=0.000, which is less than 0.05, indicating the rationality of the constructed model.

According to Equation (7), it can be seen that the β values of design elements C3 (three color types), C1 (one color type), G2 (centered position of the dragon head), and A1 (textual form of the product's main form) are 0.402, 0.659, 0.440, and 0.361, respectively, and their significances are all less than 0.05, indicating that these four elements have a significant positive impact on the aesthetic preferences of the wedding "囍" and should be applied in the design process. The β value of design element A4 (unconventional form of the product's main form) is -0.271, and its significance is less than 0.05, indicating that this element has a significant negative impact on the aesthetic preferences of the wedding "囍," and should be avoided in the design process. As for other design elements, they can be selected and determined based on aesthetic principles.

3.3 Design Presentation

Based on the analysis of the relationship between aesthetic preferences and design elements, as well as the corresponding visual elements, the design concept for the wedding "囍" character is shown in Figure 2.

Scheme 1 Scheme 2

Figure. 2 Wedding "囍" Design Schemes

4. Conclusions

This study focused on the design of wedding products under aesthetic preferences. By using the Kano model, user design requirements were obtained. The entropy theory was then employed to determine the weights of aesthetic preference imagery and the composite evaluation values of the research samples. Furthermore, the relationship between aesthetic preferences and product design elements was analyzed using stepwise linear regression. Based on these findings, design proposals were generated. Taking the wedding "囍" product as an example, the feasibility of the entire research process was demonstrated, which has improved the design quality of contemporary wedding products to a certain extent.

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