Research on Texture Imagery Design of Product Materials Based on Kansei Engineering

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Abstract

In this dissertation, a single wine glass is selected as the experimental object. Based on the theoretical basis of perceptual engineering, the material sample space and semantic space are established. The method of factor analysis and quantification are combined to construct the material image association model.To quantify consumers' perceptual cognition of product modeling material textures and to solve the association model, it is easy to obtain the correspondence relationship between product modeling material texture and consumer psychology and material preference scale, and to form a library of texture images of product textures. Through the later verification, it is proved that this method can effectively provide material selection for product design.

Keywords

Perceptual Engineering, Factor Analysis, quantification- Ⅰ theory, Quantitative Material Texture Imagery.

1. Introduction

The rapid development of the times has led to a qualitative change in people's demand for products. Humanization, diversification, and perceptualization have become the main trends in development. The functionality of the product is no longer the only focus of the user's attention, and the assessment and selection of products tends to be more emotional. At the same time, the selection of products is no longer limited to the original goal, and product considerations are more integrated and systematic. Therefore, designers must consider more and more comprehensive design elements to meet the needs of users. The selection of materials is an important element that cannot be obtained in product design. This study takes the texture imagery of the product material as the research theme. Taking the simple shape and single-material glass as an example, the theory of perceptual engineering is used to quantify the consumers' perceptual cognitive factors of the material and explore the corresponding relationship between the consumers and the texture image of the product. The degree of material preference, in order to establish a corresponding material association model, follow-up product design.

2. Literature review

2.1 Kansei engineering

Kansei engineering is a new engineering discipline. It mainly discusses a person’s psychological expectation of things and discusses the interrelationship between people. It is a technique that “transforms consumers' perceptions or images produced by products into design elements” (Chen Guoxiang, 2009). At the same time, it is also a method and a systematic program model that instructs designers to transform user's fuzzy sensory characteristics into concrete design elements.

2.2 Quantification-Ⅰ theory

Quantization is a branch of multivariate statistical analysis. It is often used in the study of sentimental engineering. It is to establish the relationship between product design elements and perceptual images, and to seek variables of a certain purpose and independent variables of other qualities. The

approximate functional relationship between items (taking a virtual variable of 0 or 1) (Wang Zhenwei, 2006). By quantifying one type of method, the degree of relevance of each qualitative item to the target variable can be determined. Each qualitative item is composed of several categories. Assume that each qualitative variable is required in all samples. And only one can be used to establish a regression formula to predict and determine the variability of external dependent variables in such goals.

3. Research process and methods:

Based on the theory and methods of perceptual engineering, this research studies the design of wine materials, establishes the relationship between consumption and perception of wine and material preferences, and the research process is shown in Figure 1.

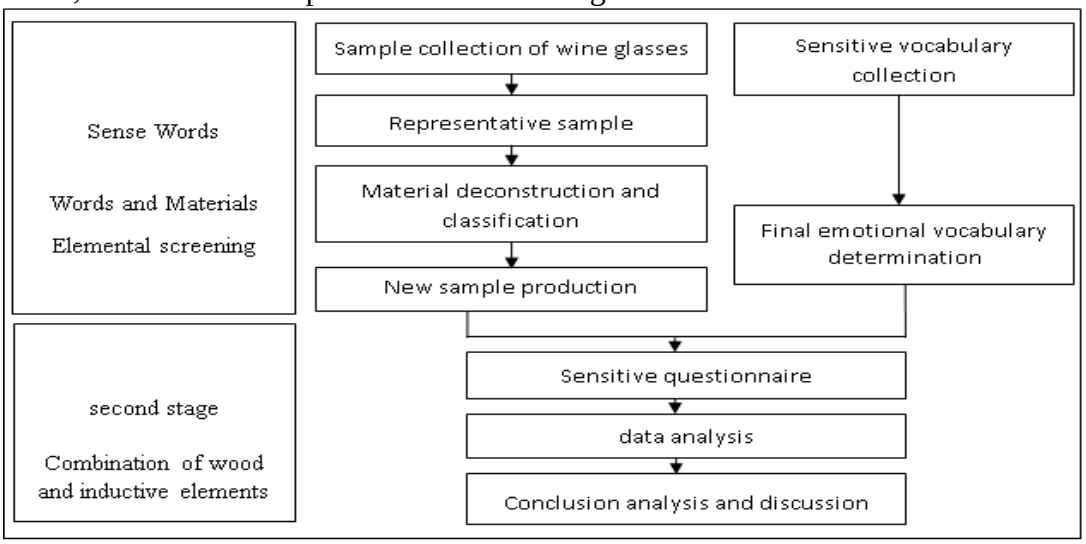

Figure 1 Study Process and Steps (Drawing from this study)

3.1 Study Material Sample Selection

Widely collect samples of different wine glasses currently on the market, including related websites, shops, periodicals, magazines, etc., initially obtain 80 samples of wine glasses, remove similar or duplicate images, keep simple shapes, single materials, and common samples. 30 remaining wine glasses pictures

The 30 samples of wine glasses were categorized according to the appearance of the main body materials, divided into four common types: metal (8), plastic (3), glass (9), ceramic (10). According to the surface visual effects, the above materials were carefully categorized into three types of metal materials (mirror, matte, brushed) and plastic materials (glossy opaque, matt opaque, translucent translucent, matte translucent, light The surface is completely transparent. Because the smooth surface is translucent, the matte translucent and clear transparent plastic material samples have almost the same effect as the glass in removing the color, so they are removed, leaving only the opaque glossy surface and opaque matt plastic) and ceramics. 2 kinds (bright surface ceramics, matt ceramics) and 3 types of glass (pure, textured, frosted). Such as table 1.

Table 1: Material Element Classification Table

Container material items	Category 1	Category 2	Category 3
ceramics	Glossy ceramics	Matt ceramics	
metal	Mirror metal	Brushed metal	Frosted metal
glass	Pure glass	Textured glass	Frosted glass
plastic	Opaque glossy plastic	Textured glass	

3.2 Material experiment sample re-draw

Choose the most representative wine glass sample from 30 sample pictures, use RHINO modeling software to redraw the 3D model according to its proportion, and match the material according to the actual material existence to make 10 new samples and sample All the color processing.

3.3 Sensitive vocabulary selection and determination

This paper selects 80 perceptual vocabularies related to wine glass materials from related magazine papers, advertisements, and information websites, and uses the focus group method to remove pejorative and material-selective non-guidance vocabularies and obtain 50 perceptual words. In order to select adjectives, the above 30 samples and adjectives were made into the first questionnaire, and 8 subjects with design experience were allowed to view the 10 pictures, and the words suitable for describing the material with emotional intent were selected and passed. Finally, 28 perceptual words were collected and paired to obtain 14 perceptual vocabulary groups. A perceptual vocabulary was added to the 14 perceptual vocabulary to reflect the experimenter's preference for materials.

Table 3: Image vocabulary of materials

1. Technology – conservative	2. Exquisite - poor	3. Unique – ordinary
4. Smooth – rough	5. Fashion – traditional	6. Perceptual - Rational
7. Elegant - Vulgar	8. Simple - Trivial	9. Cordial - Indifferent
10. Eye-catching – Mediocre	11. Simple – gorgeous	12. Hale – crushable
13. Practical - imaginary	14. Lightweight - heavy	15. Like - annoying

3.4 Experimental process:

The establishment of an effective semantic space is a prerequisite for the analysis of the effect of materials on the user's emotions. The redrawed experimental samples are matched with the sensible vocabulary groups extracted and designed as a fifth-order semantic difference questionnaire, from left to right one to five. The scores (designed as shown in the figure), a total of 25 subjects were filled in at this stage (subjects included 5 general users and 10 subjects related to the design profession). Through questionnaires, the 10 new experimental material samples and the 15 parity sensible vocabularies can be obtained, and they are organized into perceptual evaluation matrix tables.

4. Analysis and explanation of results

The perceptual ping-pong matrix obtained by the collation was analyzed by spss for factor analysis. The numerical values were obtained: by the following table

Table 4: Rotary factor analysis table

	Perceptual Image / Factor Load	factor 1	factor 2	factor 3
The first group of perceptual-rational	Technology - Conservative	-0.320	-0.082	0.892
	Refined - poor	0.526	-0.457	-0.081
	Unique - ordinary	0.356	0.097	0.213
	Smooth - Rough	-0.802	-0.364	1.136
	Fashion - Tradition	0.678	-0.016	-0.168
	Perceptual-rational	0.882	0.210	0.566
	Elegance - Vulgarity	-0.689	0.518	0.200
	Simple - trivial	-0.450	-1.364	-1.371
	Kindly - Indifferent	-2.797	-0.195	-0.401
	Eye-catching - mediocre	0.515	1.212	-2.728
The second group of simple - gorgeous	Simple - gorgeous	0.647	0.858	0.606
	Hale - Fragile	0.630	-1.759	0.221
	Practical - Virtual China	1.001	-0.785	0.178
Third Group Thick - Lightweight	Lightweight - Thick	-0.175	2.125	0.738
	Eigenvalues	3.811	1.923	1.590

	contribution	38.109 %	19.234 %	15.904 %
	Cumulative contribution	38.109 %	57.343 %	73.246 %

Table 5: Factor scores

Materials	Material index	factor 1	factor 2	factor 3
		Sensual	rustic	heavy
ceramics	1.Bright ceramic	.876	.202	.256
	2. Matte ceramics	.090	.506	.752
metal	Mirror metal	.210	.906	-.095
	4. Brushed metal	.241	.735	.334
	5. Scrub metal	-.097	.868	.033
glass	6. Pure glass	.902	.038	.095
	7. Textured glass	.165	-.046	.649
	8. Frosted glass	-.558	.078	.530
plastic	9. Opaque glossy plastic	.718	.165	.368
	10. Opaque matte plastic	-.245	-.030	-.812

The perceptual assessment matrix table was used for factor analysis. Based on the principle that factor eigenvalues were greater than 1, three common factors were extracted, and the factor load between each factor and perceptual vocabulary was as shown in Table 4. The higher factor load indicates a higher correlation between perceptual vocabulary and factors. From Table 4, it can be seen that the three factors can explain 73.246% of the variance. The texture image of the wine glass shows that it can be well explained by three factors.Comprehensively consider the emotional needs of consumers and the factor scores in Table 4 , The three factors can be summarized as follows: emotional - rational, simple - gorgeous, lightweight - after the whole. From Table 5, we can see that on the quantitative level, it is learned that matte ceramics (0.752) give people the highest heavy imagery, followed by textured glass (0.649) and opaque matte plastic (-0.812), and the rest are also the same.

In order to get a user's emotional appeal to the material as a whole, we use a quantification-like approach. In the calculation process, the average scores of the material texture and acceptance degree indicators in the perceptual questionnaire are taken as a qualitative variable, and the factor score value is used as a quantitative variable for data analysis. From Table 6, it can be seen that this type of consumer group prefers a glass with a "perceptual" material (0.0.656), followed by a "lightweight" (0.612), with the lowest level of concern for "simple" (0.414).

Table 6 Quantification Analysis Results

project	Category	Category score
Acceptance	Sensual	0.656
	pure	0.414
	Heavy	0.612

The material preference formula can be established based on the quantitative data in Table 6:Substituting this score into the formula :

$$y = (a, b, c, d \cdots n)\begin{bmatrix} b_{yy} & b_{y1} & b_{y2} & b_{y3} & \cdots & b_{yr} \\ b_{11} & b_{12} & b_{13} & b_{14} & \cdots & b_{1r} \\ b_{21} & b_{22} & b_{23} & b_{24} & \cdots & b_{2r} \\ \vdots & \vdots & \vdots & \vdots & & \vdots \\ b_{r1} & b_{r2} & b_{r3} & b_{r4} & \cdots & b_{rr} \end{bmatrix}\begin{bmatrix} r_1 \\ r_2 \\ r_3 \\ \vdots \\ r_n \end{bmatrix} + E$$

Among them, Y is a material preference coefficient, (a,b,c,d...n) represents a material category, E is a material preference prediction constant, and the value is 5.286. If the cup is a glossy ceramic, a = 1 remaining b, c, d ... n is 0, bright surface ceramic material preference is 6.101, and so on can get the preference coefficient of each material value, collated to obtain Table 7.

The Y table 7 :material preference table

project	Category	Predictive value A	Predictive value B
ceramics	1.Bright ceramic	6.101	6.08
	2. Matte ceramics	6.014	
metal	Mirror metal	5.740	5.765
	4. Brushed metal	5.952	
	5. Scrub metal	5.602	
glass	6. Pure glass	5.951	5.667
	7. Textured glass	5.772	
	8. Frosted glass	5.276	
plastic	9. Opaque glossy plastic	6.050	5.333
	10. Opaque matte plastic	4.616	

From the above data analysis, we can conclude that the consumer's common perceptual knowledge of the material is “perceptual, simple, and heavy”; from the values, the user prefers the glossy ceramic to the selection of wine glasses. , Opaque glossy plastic, matt ceramic, followed by brushed metal, pure glass, textured glass, mirrored metal, frosted metal, frosted glass, opaque matt plastic. Through this, I hope to provide designers with reference to the selection of materials.

5. Conclusion

The purpose of this dissertation is to explore the cognitive imagery between the material texture and perceptual vocabulary of the product and the preference of material selection, so as to better transform this vague cognitive image into a figurative design element. By analyzing the material of the product using wine glasses as the carrier, the detailed material category categories are summarized and analyzed by factor analysis and quantification to define the relationship between perceptual vocabulary and materials and the strength of their preferences. The design is expected. The process can provide a reference for product development and application.

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