The Research of Product Design Evaluation Method Based on Brand Intention Recognition

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Abstract. Traditional designers generally make subjective evaluation and decision-making based on their perceptual experiences, while the speed of current products replacement are becoming faster and the design objects are becoming more complex. The rapid development of information technology requires product design evaluation scientific and systematic. Only relying on intuition, subjective evaluation and decision-making cannot meet the demands of the times. So, to find a systematic and scientific product design evaluation approach is the objective requirement of the promotion enterprise's brand value and the reality of user satisfaction of product requirements. This paper attempts to apply the theory of Kansei Engineering to establish a set of practical evaluation for product design. On the basis of the user experience of brand and its products, collected perceptual evaluation data through questionnaires for factor analysis methods, using the combination of product design principles to determine the product objectives and model of design evaluation to establish a brand value of the product design evaluation methods. Based on Kansei Engineering, brand building and product perceptual evaluation of image space and evaluation standard. On the basis of user perceptual evaluation to determine the criteria weight coefficients of correlation, and then on product design target for the design of accurate positioning, forming a system of brand value enhancement oriented product design evaluation system.

Keywords: Kansei Engineering, Image, Design Evaluation, OLED Lamps.

1 Introduction

With the advent of new technologies, products based on these new technology are increasing. However, the lack of similar products as a reference, new technology products will faced with many uncertainties when entering the market, how do consumers think of new technology products, how about their degree of recognition, satisfaction? whether the products Meets their expectations of new products or not, etc.? This paper attempts to apply the theory of sensibility Engineering to OLED lighting products design development, evaluate it, to judge contact between lighting products and emotional needs of consumers.

Sensibility engineering is a design techniques proposed by Japanese scholars in the 1970s, It change consumers' emotion to the product design elements[1], It is divided

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into forward, reverse and forward and reverse combination these three types of sensibility Engineering. the reverse sensibility engineering is part of the designer support systems, It's mainly used to evaluate the Design of designers emotionally, to help designers grasp the characteristics of products, understand the relationship between products and consumer's sensibility, To determine whether the designer's design concept meet consumer expectations or not[2]. According to the research objectives we proposed research process shown in Figure 1:

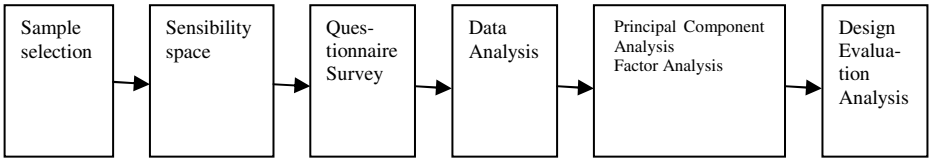

Fig. 1. Research process

The main contents of this study:

First, we use 45 OLED lamps design as samples, On the basis of full discussion, people involved in the design of lighting identified three lighting design as our study objects. And select program 1, program 2 and program 3 renderings as the evaluation object.

Secondly, in order to determine the respondent's feel and preferences of the three programs, we select 120 emotional adjectives about lamps from books, newspapers, magazines, advertising and other media, finalized 10 pairs of sensibility space[3]. Expressed as{V1,V2,V3,V4,V5,V6,V7,V8,V9,V10}={ Expensive - cheap, personality - public safety - the dangerous freedom - detention, figurative - abstract, innovation - imitation, fine - rough, exaggerated - restrained and elegant - tacky, soft - fortitude }.

Fig. 2. Three evaluation object finalized

Again, According to the above emotional vocabulary and design samples, design questionnaire survey by the semantics difference method. according to respondents own sense ,they were asked to select vocabulary by understanding and personal preference, Each pair of Kansei vocabulary with five levels to distinguish the degree of preference.

Additionally, selected survey object. Mainly divided into two categories: designers and ordinary consumers, As the population in different areas concern different angles and details, In order to analyze easily, The selected survey object's Category, code and the number of investigations are as shown in Table 1.

Table 1. Survey information and the corresponding code table

Variable name	Category	Code	Number of people	Percentage%
designer	designer	Pd	15	100%
Sex	Male	P1	30	60%
	Female	P2	20	40%
Educational background	Master and above	P3	33	66%
	Undergraduate and below	P4	17	34%
Monthly income	5000￥below	P5	27	54%
	5000-10000￥	P6	23	46%

Finally, the data analysis. use semantic differences and factor analysis, measure out the average data of observed values based on emotional vocabulary, While by gender, age, education and income status, as measured by factors such as predictive value, find out the association; If the consumer emotional preferences and lamps correspondence on statistical data, It can be speculated that the lamps sample correlation with consumers emotional preferences.

2 Perceptual Evaluation of OLED Lighting Design Programs

2.1 Sample 1 Perceptual Evaluation and Analysis

From table 2, We can draw designers and male and female consumers in the [innovation - imitation] value are difference at 1.8 and 1.95, show emotional evaluate differences between designers and consumers, Designers is not completely reflect its imagery in sample 1. designers and consumer's Monthly income 5000￥ and 5000-10000￥below in the [innovation - imitation] value are difference at 1.87 and 1.81, show emotional evaluate differences between designers and those consumers, Designers is not completely reflect its imagery in sample 1 too Designers and consumers who are undergraduate and below in the [innovation - imitation] value are difference at 2.17, show huge emotional evaluate differences between designers and those consumers in sample 1.

Table 2. OLED lighting sample 1 perceptual evaluation data analysis table

Emotional vocabulary	P_d	P_1		P_2		P_d	P_3		P_4		P_d	P_5		P_6	
	average value	average value	Differ with Pd	average value	Differ with Pd	average value	average value	Differ with Pd	average value	Differ with Pd	average value	average value	Differ with Pd	average value	与Pd差异
V_1	-0.59	-0.29	0.30▲	-0.69	0.1▲	-0.59	-0.5	0.09▲	-0.21	0.38	-0.59	-0.21	0.38	-0.5	0.09▲
V_2	-0.66	-0.96	0.03▲	-0.54	0.12▲	-0.66	-0.81	0.15▲	-0.86	0.20▲	-0.66	-0.1	0.56	-0.73	0.07▲
V_3	-0.59	-1.07	0.48	-0.85	0.26▲	-0.59	-1.12	0.53	-0.79	0.20▲	-0.59	-1.07	0.48	-0.96	0.37
V_4	-0.28	-0.85	0.57	-0.69	0.41	-0.28	-1.04	0.76	-0.36	0.08▲	-0.28	-0.93	0.65	-0.73	0.45
V_5	0.07	0.48	0.41	-0.15	0.08▲	0.07	0.38	0.31▲	0.07	0	0.07	0.5	0.43	0.15	0.08▲
V_6	1.1	-0.7	1.8★	-0.85	1.95★	1.1	-0.77	1.87★	-0.71	1.81★	1.1	-1.07	2.17★	-0.58	1.68★
V_7	-0.83	-0.93	0.1▲	-0.77	0.06▲	-0.83	-0.88	0.05▲	-0.86	0.03▲	-0.83	-0.71	0.12▲	-0.96	0.13▲
V_8	0.14	-0.04	0.1▲	0.08	0.06▲	0.14	0.15	0.01▲	-0.29	0.43	0.14	-0.14	0.28▲	0.08	0.22▲
V_9	-0.9	-1.19	0.39	-0.77	0.13▲	-0.9	-1.08	0.18▲	-1	0.1▲	-0.9	-1.43	0.53	-0.85	0.05▲
V_{10}	0.21	-0.33	0.54	-0.15	0.36	0.21	-0.38	0.59	-0.07	0.28▲	0.21	-0.36	0.57	-0.23	0.44

Note: If the designers and consumers are basically the same, then use ▲ ; On the contrary, there are significant differences as designers and con sumers in the evaluation of emotional awareness, use ★.

Table 3. OLED lighting sample 2 perceptual evaluation data analysis table

Emotional vocabulary	P_d	P_1		P_2		P_d	P_3		P_4		P_d	P_5		P_6	
	average value	average value	Difference with Pd	average value	Difference with Pd	average value	average value	Difference with Pd	average value	Difference with Pd	average value	average value	Difference with Pd	average value	Difference with Pd
V_1	-0.38	-0.04	0.34	0	0.38	-0.38	-0.12	0.26 ▲	0.14	0.24 ▲	-0.38	-0.07	0.31 ▲	0	0.38
V_2	-0.38	-0.52	0.14 ▲	-0.69	0.31 ▲	-0.38	-0.58	0.20 ▲	-0.57	0.19 ▲	-0.38	-0.57	0.19 ▲	-0.58	0.20 ▲
V_3	-0.28	-0.7	0.42	-1.08	0.8	-0.28	-0.73	0.45	-1	0.72	-0.28	-0.36	0.08 ▲	-1.08	0.8
V_4	-0.59	-0.85	0.26 ▲	0	0.59	-0.59	-0.77	0.18 ▲	-0.21	0.38	-0.59	-0.64	0.05 ▲	-0.54	0.05 ▲
V_5	0.52	-0.41	0.93	-0.15	0.67	0.52	-0.69	1.21 ★	0.14	0.38	0.52	-0.29	0.23 ▲	-0.35	0.17 ▲
V_6	-0.66	-0.67	0.01 ▲	-0.23	0.43	-0.66	-0.54	0.12 ▲	-0.5	0.16 ▲	-0.66	-0.43	0.23 ▲	-0.58	0.08 ▲
V_7	-1.14	-0.81	0.33	-0.85	0.29 ▲	-1.14	-0.73	0.41	-1	0.14 ▲	-1.14	-0.79	0.35	-0.85	0.29 ▲
V_8	-0.17	-0.26	0.09 ▲	-0.15	0.02 ▲	-0.17	0.04	0.21 ▲	-0.71	0.54	-0.17	-0.29	0.12 ▲	-0.19	0.02 ▲
V_9	-0.48	-0.96	0.48	-0.46	0.02 ▲	-0.48	-0.81	0.33	-0.79	0.31 ▲	-0.48	-0.86	0.38	-0.77	0.29 ▲
V_{10}	-1.1	-0.89	0.21 ▲	-0.77	0.33	-1.1	-0.85	0.25 ▲	-0.86	0.24 ▲	-1.1	-0.71	0.39	-0.92	0.18 ▲

Table 4. OLED lighting sample 3 perceptual evaluation data analysis tab

Emotional vocabulary	P_d	P_1		P_2		P_d	P_3		P_4		P_d	P_5		P_6	
	aver-age value	average value	Differ with Pd	aver-age value	Dif-fer with Pd	aver-age value	aver-age value	Dif-fer with Pd	aver-age value	aver-age value	aver-age value	aver-age value	Dif-fer with Pd	aver-age value	Dif-fer with Pd
V_1	-0.52	-0.89	0.37	-0.62	0.10▲	-0.52	-0.85	0.33	-0.71	0.19▲	-0.52	-0.71	0.19▲	-0.85	0.33
V_2	-1.14	-1.33	0.19▲	-1.31	0.17▲	-1.14	-1.54	0.4	-0.93	0.21▲	-1.14	-1.36	0.22▲	-1.31	0.17▲
V_3	-0.24	-0.59	0.35	0.15	0.09▲	-0.24	-0.5	0.26▲	-0.07	0.17▲	-0.24	-0.36	0.12▲	-0.35	0.11▲
V_4	-0.03	-1.15	1.12★	-1.15	1.12★	-0.03	-1.27	1.24★	-0.93	0.9	-0.03	-1.07	1.04	-1.19	1.16★
V_5	-0.21	0.26	0.47	-0.08	0.14▲	-0.21	0.35	0.56	-0.21	0.00▲	-0.21	0.07	0.28▲	0.19	0.4
V_6	-0.52	-1.11	0.59	-1.62	1.10★	-0.52	-1.46	0.94	-0.93	0.41	-0.52	-1.21	0.69	-1.31	0.79
V_7	-0.1	-0.81	0.71	-1.15	1.05	-0.1	-1	0.9	-0.79	0.69	-0.1	-1	0.9	-0.88	0.78
V_8	-0.93	-1	0.07▲	-1.08	0.15▲	-0.93	-1.12	0.19▲	-0.86	0.07▲	-0.93	-1.14	0.21▲	-0.96	0.03▲
V_9	-0.17	-1.11	0.94	-0.69	0.52	-0.17	-1	0.83	-0.93	0.76	-0.17	-1.21	1.04	-0.85	0.68
V_{10}	0.28	0.3	0.02▲	0.15	0.13▲	0.28	-0.27	0.55	-0.21	0.07▲	0.28	-0.36	0.64	-0.19	0.47

Table 5. Initial variable

	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}
V_1	1.000	0.955	-0.618	0.575	-0.222	0.848	0.295	0.713	0.330	0.329
V_2	0.955	1.000	-0.707	0.629	-0.327	0.931	0.396	0.839	0.358	0.284
V_3	-0.618	-0.707	1.000	-0.589	0.155	-0.741	0.100	-0.916	0.188	-0.094
V_4	0.575	0.629	0-.589	1.000	-0.519	0.712	0.252	0.740	0.328	0.564
V_5	-0.222	-0.327	0.155	-0.519	1.000	-0.312	-0.657	0-.290	-0.629	-0.267
V_6	0.848	0.931	-0.751	0.712	-0.312	1.000	0.415	0.875	0.340	0.462
V_7	0.295	0.396	0.100	0.252	-0.657	0.415	1.000	0.138	0.828	0.480
V_8	0.713	0.839	-0.916	0.740	-0.290	0.875	0.138	1.000	0.043	0.237
V_9	0.330	0.358	0.188	0.328	-0.629	0.340	0.828	0.043	1.000	0.526
V_{10}	0.329	0.284	-0.094	0.564	-0.267	0.462	0.480	0.237	0.526	1.000

2.2 Sample 2 Perceptual Evaluation Data Analysis

From table 3, We can analyze the difference of designers and male consumers in[Personality - public], [freedom - detention], [innovation - imitation], [exaggerated - introverted], [soft - fortitude] are within 0.32, Designer's emotional cognitive and emotional vocabulary is basically the same with male consumers ; the difference of designers and female consumers in[Personality - public], [rough - Fine], [exaggerated - introverted], [elegant - tacky]are qithin 0.32, Designer's emotional cognitive and emotional vocabulary is basically the same with female consumers. the difference of designers and consumers whose monthly income are below 5000￥ in[Figurative - abstract]is within 1.21, there were significant differences in designer and such consumers, Designer's grasp of [Figurative - abstract] is not accurate. The difference of designers and master and above in[Personality - public], [freedom - detention], [figurative - abstract], [innovation - imitation], [fine - rough], [exaggerated - introverted], [elegant - the tacky], [soft - fortitude]are within 0.32, Designer's emotional cognitive and emotional vocabulary is basically the same with master and above.

2.3 Sample 3 Perceptual Evaluation Data Analysis

From table 3, We can analyze the difference of designers and male consumers in[Freedom - imprisonment] are within 1.12, Designer's emotional cognitive and emotional vocabulary has big difference with male consumers ; the difference of designers and female consumers in[Freedom - detention], [innovation - imitation] are 1.12 and 1.10, Designer's emotional cognitive and emotional vocabulary has big difference with female consumers ; the difference of designers and consumers whose monthly income are below 5000￥ in[Freedom - imprisonment]is within 1.24, Designer's emotional cognitive and emotional vocabulary has big difference with these consumers ; Designer's grasp of [Freedom - imprisonment] is not accurate. The difference of designers and master and above in[Freedom - imprisonment]are within 1.16, Designer's emotional cognitive and emotional vocabulary has big difference with these consumers. designer's grasp of [Freedom - imprisonment] is not accurate.

Through the above research, we find out the differences between the various groups of consumers' and designers in cognitive perceptual evaluation of each sample OLED lighting product. This article will be followed by further integration of OLED lighting products analysis which is not easy to master[4]. In the next study, we will analysis relevance of each single sample its evaluation of Cognitive and appearance, which focuses on the individual consumer groups, whose emotional evaluation is not easy to grasp for designer.

3 Relevance Analysis

This paper using principal component for factor analysis, assuming that the variable is a linear combination of pure factor. According to the principle that factor eigenvalues

greater than 1 is needed to determine which components should be retained. The first component's variance percentage explained is maximum in the total variance, the next component of the variance explained decrement. their cumulative contribution rate shows percentage of common factor contained. If the cumulative contribution rate is high, indicating that the factor model's part can explained the original variables [5]. This paper extracted three main factors from the original array, 86.283% of the total variance. Factor analysis on Sensibility data draw Correlation matrix(Table 6)and Factor Scree plot(figure 3).

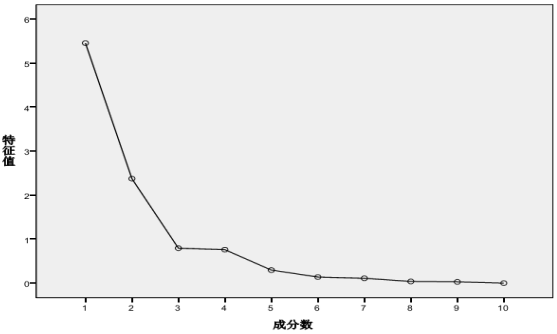

Fig. 3. Scree plot

From figure 3, we can see that the eigenvalues is higher before factor no.3, Connected into a steep curve, after factor no.6 there has been a certain change, after this the eigenvalues is low, this shows that the three factors we extracted are appropriate. After the correlation coefficient matrix orthogonal rotation, we get the following orthogonal factor loadings table, arranged by the different sizes of factor loadings, we get factor loading table as table 7 below.

Table 6. The initial component loading matrix

	component		
	1	2	3
V_1	0.855	-0.179	-0.069
V_2	0.926	-0.173	-0.182
V_3	-0.707	0.624	0.060
V_4	0.821	-0.020	0.272
V_5	-0.528	-0.544	0.354
V_6	0.950	-0.153	0.033
V_7	0.508	0.761	-0.192
V_8	0.862	-0.432	-0.049
V_9	0.480	0.811	-0.071
V_{10}	0.528	0.426	0.712

Note: Main component a. has been extracted three component.

Table 7. Component loading matrix after varimax orthogonal rotated

	成份		
	1	2	3
V_1	0.834	0.234	0.138
V_2	0.906	0.315	0.058
V_3	-0.924	0.194	0.030
V_4	0.685	0.213	0.485
V_5	-0.228	-0.805	0.003
V_6	0.889	0.254	0.266
V_7	0.085	0.909	0.204
V_8	0.962	0.023	0.082
V_9	0.022	0.889	0.320
V_{10}	0.159	0.279	0.930

Note: By using Kaiser standardized orthogonal rotation method a. Rotation convergenced after five iterations [6].

As shown in Table 7, the initial load matrix implement the of the maximum variance components orthogonal rotation, we get "Rotated component matrix" as shown in table 8, and we know the first public factor high load variables are Expensive and inexpensive, personality and public safety and danger, innovation and imitation, exaggeration and introverted, freedom and imprisonment, according to its semantic, they are summed up as style factor. The second public factor high load variables are concrete and abstract, fine and coarse, elegant and tacky, summed up as quality factor. The third public factor high load variables are Soft and fortitude, summed up as value factor, As shown in Table 9.

Table 8. Common factor data Sheet

Common factor	Emotional semantic space	Higher load factor	Eigenvalues	Variance contribution rate	Cumulative contribution rate
factor 1（Style factor）	V_1	0.834	4.640	46.402%	46.402%
	V_2	0.906			
	V_3	-0.924			
	V_4	0.889			
	V_5	0.962			
	V_6	0.685			
factor 2（Quality factor）	V_7	-0.805	2.643	26.429%	72.830%
	V_8	0.909			
	V_9	0.889			
factor 3（Value factor）	V_{10}	0.930	1.345	13.452	13.452%

Figure 4 is a three-dimensional map consisting of three common factors, It can be seen that the high load indicator on the first component is the style factor, the high load indicator on the second component is the quality factor, the high load indicator on the third component is the value factor.

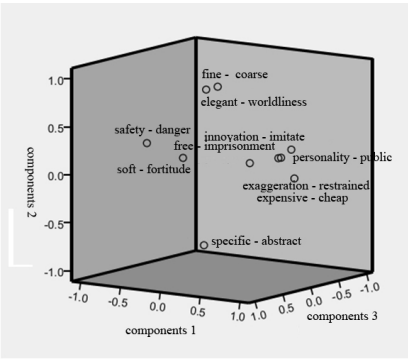

Fig. 4. Three-dimensional component chart in a rotating space

Table 9. component score coefficient table

	component		
	1	2	3
V_1	0.183	0.038	-0.055
V_2	0.210	0.103	-0.180
V_3	-0.250	0.131	0.108
V_4	0.093	-0.083	0.353
V_5	-0.023	-0.407	0.308
V_6	0.177	0.003	0.070
V_7	-0.049	0.398	-0.096
V_8	0.233	-0.058	-0.064
V_9	-0.082	0.351	0.047
V_{10}	-0.113	-0.175	0.896

Note: Extraction Methods: Kaiser standardized orthogonal rotation method.

As shown in figure 4 and Table 9,10, In the OLED lighting design elements emotional vocabulary imagery evaluation analysis, style factor,quality factor,value factor separately explained the overall variance 46.40%、26.43%、13.45%。 style factor is common factor of V1、V2、V3、V4、V5、V6, from the factor score coefficient matrix, we can get that V2、V3、V5 can deside style factor ; quality factor is common factor of V7、V8、V9, we can get that V7、V8、V9 can deside quality factor ; value factor is common factor of V10, we can get that V10 can deside value factor ; Therefore, when we begin to design, we should pay more attention to the factors which affect common factor the most, so as to grasp the direction and positioning of design more accurately.

Table 10. Consumer's perceptual evaluation point analysis and comparison chart

	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}
program1	-0.4	-0.83	-1.00	-0.8	0.28	-0.75	-0.88	0.00	-1.05	-0.28
program2	-0.03	-0.58	-0.83	-0.58	-0.33	-0.53	-0.83	-0.23	-0.8	-0.85
program3	-0.8	-1.33	-0.35	-1.15	0.15	-1.28	-0.93	-1.03	-0.98	-0.25

As shown in Table 10, You can get the program 3 LED lamps designed sample have very good Consumer acceptance, it get higher sensibility evaluation too, This OLED lighting design is superior to other designs in the consumer's sensibility imagery. the program 1 LED lamps designed sample have good Consumer acceptance, it get good sensibility evaluation, it has better than the program 1 in the consumer's sensibility imagery. Of course, if we can absorb the advantages of each program, remove the shortcomings of each program, re-arranged and re-combination the design, we will be able to design a more excellent product.

4 Conclusion

Based on The sensibility engineering, this article propose a set of relatively complete user-oriented product design evaluation methods and procedures, to sum up, it mainly addresses the following three issues. First, this study is based on OLED lighting products design under the new technology, combining The sensibility engineering methods and product design, and tried to blend the emotional needs of the user into OLED lighting style, design quality and design values, expexting the OLED lighting product design orientation is consistent with user expectations. Secondly, based on careful analysis of the emotional needs of users on OLED lighting, we use semantic differential method in survey, And analyze the collected sensibility data, contrast perceptual cognitive differences of product design between consumers and designers, in order to evaluate if the product's positioning of designers accord to user, to achieve product design evaluation and optimization, trying to meet new technology product design evaluation's systematic, objective requirements.

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