

Evaluation and Research on Interior Decoration Design of Automobile Cabins Based on Intention Recognition – Taking Control Panel Design for an Example

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Abstract. The Article tries to apply Kansei Engineering theory to build up a relationship between the design elements for control panel design of automobile cabins and the perceptual evaluation of users. By integrating design features of the automobile control panel with the evaluation procedure for perceptual image design, an association model is finally established between the design elements for the control panel relating to the interior decoration of automobile cabins and the perceptual evaluation of users through screening of design patterns for the control panel, cognitive study on the perceptual image and by using the composition of design element system. During the study, perceptual evaluation data of test samples is obtained with the method of semantic differential. Combined with the design decomposition elements obtained via morphological analysis, an association model between the design elements and the perceptual evaluation is obtained with factor analysis method to determine the relationship of them and help to forecast the perceptual evaluation value. The article establishes a forecast that the association model can be used for the perceptual evaluation value of cabin interior decoration, and forms a set of systematic and scientific evaluation methodology for the interior decoration design of automobile cabins by describing and verifying the design methods for the control panel in cabins.

Keywords: Control panel design · Intention recognition · Kansei Engineering

1 Introduction

People began to transfer attention to the automotive interior gradually from the born of car when they tirelessly pursued the automotive mechanical properties and appearance in Nineteenth Century. Whether the auto control design was good or bad directly related to the evaluation of people driving experience, the comfortable, entertaining and easy operation affected the automobile industry development greatly [1]. Different interior systems been placed in the environment of man - cockpit took different levels of impact to the driver's psychological and physiological, thereby affected the drivers' operation. In the field of design, using the method of Kansei Engineering could

combine the design elements and the user's feelings, and establish the model of the relationship between the two [2]. TANOU in Japan [3], HSIAO in Taiwan, China etc. [4] all used these research means.

Therefore, this paper used the theory of Kansei Engineering, took the central console of the intermediate car in the market as the research object of the design evaluation, in order to produce the product design evaluation method which was in line with the consumer's perceptual demand.

2 Introduction of Kansei Engineering

The term of "Kansei Engineering" was first proposed by Japanese scholars in the speech of "the theory of automobile culture" at the University of Michigan in 1986 [5]. It was a theory or method to explore the relationship between the "human" sensibility and design characteristics of the "object" by using engineering technology [6, 7]. In the process of product design, the core part of the emotional design was to take emotional images and feelings into the elements of product design, help designers to grasp the product characteristics, understand its relationship with consumer sensory images, so as to determine whether these evaluations were in line with the designers' intentions at image.

3 The Design Overview of Car Cockpit Interior

Central control console, door trim, instrument panel, seat, steering wheel, etc. all belonged to the automotive interior. The dashboard, door trim, seats were paid more attention by people. In contrast, the console was often easy to be ignored, and was rarely involved even in the automotive related research. But with the development of automobile industry, console was given more functions, for example: giving drivers more driving information, improving the comfort and automatic operation, increasing more control panel and display, all kinds of audio equipment, air conditioning equipment switch, glove box, cup holder and so on, which made it become a very important part of the automobile interior design. As a result, it should be paid more attention in the automotive development and design phase.

Console layout mainly included two forms, the one was independent existence between the driving seat and the deputy driving seat which was common in the mini car or truck; another was connected together with the dashboard, which was common in high-grade car, this paper took the console in this form as the research object.

4 Research Scheme Design under the Framework of Kansei Engineering

Research method of the Kansei Engineering was introduced in this paper, it took four steps to establish the evaluation model of the automobile control platform. First of all, collecting the representative samples of the vehicle console which took a clear design

orientation, next building the control system and the related model of console based on on the perceptual image cognition of the central control station, so as to determine the relationship between the user’s perceptual evaluation and the design elements of the central control station, and use the obtained perceptual evaluation to guide the design of the automobile control platform.

- 1. *Collecting samples the car console which took a clear design orientation.* The console design evaluation from the perceptual image started from the target user’s demand survey research, the difference of design positioning meant that the corresponding user perceptual cognition and demand were different. Therefore, it should clear the design and positioning of the console samples firstly, clear product target user group. Secondly, it should collect 58 sample table modeling pictures of console extensively, classify these pictures preliminary, subjective screen on the basis of clarity and angle, determine a set of representative sample pictures, and use gray treatment to remove the color factor, as shown in Fig. 1.



Fig. 1. The representative samples of the console

- 2. *Determining the representative perceptual vocabulary.* Collecting emotional adjectives which were descriptions of console as much as possible according to the manufacturer’s website, books, magazines, newspapers and consumer interviews and other ways, excluding semantic fuzziness vocabularies by screening, selecting residual perceptual describe words through questionnaire and cluster analysis, and choosing 6 groups most from a hierarchical perceptual vocabulary descriptions of the console. As shown in Table 1:

Table 1. The representative perceptual vocabulary

Code	Y1	Y2	Y3	Y4	Y5	Y6
perceptual vocabulary	quality	technological	novel	concise	eye-catching	streamline

- 3. *Determining user questionnaire.* Determining the representative quotations by the numbers of representative samples and combination, and establishing the semantics difference scale table of vehicle console. Controlling the reliability and validity of the scale table in order to ensure the accuracy of the survey.
- 4. *The evaluation and analysis of the user to the automobile console.* Through Users evaluated the representative samples of the console by the questionnaire, so as to obtain the user’s perception of the console.

5. *Establishing the relationship model between the model elements and the perceptual evaluation of the vehicle console and drawing the conclusion.* Determining the main product features and design elements of the representative samples, and transforming the perceptual evaluation to the engineering scale by the gray data theory and multiple regression analysis. Summarizing the corresponding relationship between the modeling elements and the perceptual evaluation of the car console, and concluding the evaluation method of the vehicle console based on the perceptual image.

5 Method Validation

The car console design was taken as a case in this paper, it determined that the target consumers of car were college graduates about 5 years, their consumption patterns were dominated by their internal psychological factors with distinctive psychological characteristics. The representative sample in this experiment were determined through this method, and were classified and analyzed by using the method of multiple scales, design personnel classification standard and coordinate value were found through the SPSS software, the pictures of final samples were obtained through clustering analysis.

The evaluation of users to the car console were got by the network questionnaire in this time, the questionnaire contained personal information, the car console evaluation and the car console needs these three parts, as shown in Fig. 2.

根据样本6中控台图片和形容词逐行打分

品质的	1	2	3	4	5
科技的	1	2	3	4	5
新颖的	1	2	3	4	5
简洁的	1	2	3	4	5
抢眼的	1	2	3	4	5
流线的	1	2	3	4	5




Fig. 2. The questionnaire about car console

The questionnaire data and descriptive statistical analysis were done, and the data matrix of the console sample was obtained, as shown in Table 3. 6 sets of perceptual vocabulary were setted as the variable X to make the decision of the principal component analysis, and the main component of the contribution rate and the high load factor of the common factor were obtained.

As shown in Table 2, the rotated component matrix was obtained through the initial component load matrix of varimax orthogonal rotation, it could be seen the first common factors of high load variables were Y2, Y3, Y5, which were classified as form factor according to the semantic. The second the high load factor on the high load was Y1, Y6 was the second common factor on the high load of variables, which defined as the quality factor. Y4 was the variable of high load on the third factor, which was defined as the value factor. Thus, the semantic core of the 6 groups perceptual words were summed up, and potential factors were dug out.

Table 2. Common factor data sheet

Common factor	Perceptual vocabulary	Factor load	Characteristic value	Variance contribution rate/%	Cumulative contribution rate/%
Factor 1 (form factor)	Y2	.805	4.141	69.021	69.021
	Y3	.941			
	Y5	.932			
Factor 2 (quality factor)	Y1	.766	1.172	29.530	88.550
	Y6	.947			
Factor 3 (value factor)	Y4	.999	.624	10.397	98.948

The component score coefficient matrix was obtained according to the Thomson regression method, and the spatial model of console perceptual image was set up as follows:

Form factor = $-0.202Y1 + 0.259Y2 + 0.562Y3 - 0.013Y4 + 0.500Y5 - 0.300Y6$.

Quality factor = $0.357Y1 - 0.097Y2 - 0.210Y3 - 0.031Y4 - 0.230Y5 + 0.956Y6$.

Value factor = $-0.129Y1 + 0.172Y2 + 0.032Y3 + 0.963Y4 - 0.134Y5 + 0.026Y6$.

Perceptual image spatial model described the constitution of the automobile console from the perspective of semantics. The console design elements and image spatial were explored further in this paper, as shown in Table 3, the function mapping relationship between design elements and emotional semantic were established through multiple linear regression method, and emotional design concept model of console was proposed.

As shown in Table 4, the relevance amount of design elements to the emotional vocabulary could be found according to the design factor regression analysis coefficient table. Taking the quality of sense as an example, when a user needed a “sense of

Table 3. Data samples

Sample	Perceptual vocabulary value						Design elements								
							Navigation radio panel(X1)			Air outlet of air conditioner(X2)			Control button configuration(X3)		
	Quality	Technological	Novel	Concise	Eye-catching	Streamline	Square (C11)	Polygon (C12)	Arc line (C13)	Trapezoid (C21)	Circular (C22)	Quality (C23)	Technological (C31)	Novel (C32)	Concise (C33)
T1	3.2	2.93	2.33	3.07	2.13	2.93	1	0	0	0	0	1	0	0	1
T2	3.13	3.07	2.97	3	2.73	2.7	1	0	0	0	1	0	0	0	1
T3	2.8	2.73	2.4	2.53	2.37	2.5	0	0	1	1	0	0	0	0	1
T4	2.8	2.7	2.4	2.43	2.4	2.67	0	1	0	1	0	0	0	1	0
T5	3.13	3.23	2.8	3.2	2.9	2.63	0	1	0	1	0	0	0	1	0
T6	3.47	3.4	3.3	2.57	3.67	3.2	0	0	1	0	0	1	1	0	0

Table 4. Linear regression coefficient table of design elements

Perceptual vocabulary Y	The design elements of the automobile console								
	C11	C12	C13	C21	C22	C23	C31	C32	C33
Y1	0.232	-0.373	0.141	-0.763	0.08	0.746	0.73	-0.373	-0.192
Y2	0.028	-0.126	0.154	-0.487	0.106	0.433	0.689	-0.126	-0.395
Y3	-0.099	-0.199	0.298	-0.468	0.339	0.229	0.754	-0.199	-0.375
Y4	0.556	0.036	-0.592	-0.268	0.299	0.047	-0.344	0.036	0.223
Y5	-0.381	-0.071	0.452	-0.286	0.027	0.282	0.866	-0.071	-0.579
Y6	0.133	-0.374	0.241	-0.746	-0.139	0.901	0.832	-0.374	-0.268

quality”, the design relationship between elements according to: The $C23 = 0.746 > C31 = 0.73 > C11 = 0.232 > C13 = 0.141 > C22 = 0.08 > C33 = -0.192 > C12$
 $C32 = -0.373 > C21 = -0.763$, that the importance sort which affected the users’ “sense of quality” was shown: air conditioning out tuyere half arc, a control button cylindrical, navigation radio square panel, navigation radio panel arc shaped, air out of round outlet, a control button hybrid, navigation radio panel polygon, control button forms mixed type, air conditioning out tuyere ladder.

6 Conclusion

The automobile console design was analyzed from the perspective of industrial design in this paper, the quantization value of automobile console form image was found by using of artistic psychology with perceptual image theory, the semantic core and potential factor were summarized which under the perceptual meaning by combining with factor analysis method, the form image model of automobile console was established. Subsequently, the correlation model was got through multiple regression analysis design elements and perceptual image, which provided a scientific reference for automobile console design, and helped designers design car console which could meet users’ psychological needs.

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