Research on the Design Method of Extracting Optimal Kansei Vocabulary

Xinhui Kang(✉), Minggang Yang, Yixiang Wu, and Haozhou Yuan

School of Art, Design and Media,
East China University of Science and Technology,
No. 130 Meilong Road, Xuhui District, Shanghai 200237, China
2634175918@qq.com

Abstract. In the relevant researches on Kansei Engineering, the Kansei Vocabulary extraction has a vital significance. In previous time, the Kansei words are selected by experts' focus interviews or customers' giving marks. Such kind of method is easy, but it is difficult to explore the customers' inner feeling, which seems to be so hasty. In this research, a method of selecting optimal Kansei Vocabulary is proposed to assist the designers establish the high correlation degree's emotion cognition of customers. The factor analysis is used to classify the Kansei semantic style. Using the Fuzzy Analytic Hierarchy Process to make comparisons of each two specific Kansei words can get the final weight order. Through this method in the minicar's case study, the modern factors' "concise", "smooth" words are defined as the words which can most arouse the customers' emotional resonance. The research proves that the design method of extracting the optimal Kansei Vocabulary is the most effective one. Meanwhile, it can be applied into the modeling design of other industrial products.

Keywords: Kansei engineering · Minicar · Fuzzy analytic hierarchy process · Kansei vocabulary · Semantic attributes (SA)

1 Introduction

In this research, the author classifies the relevant Kansei words of the screening minicars by utilizing the fuzzy analytic hierarchy process to make comparisons of each two quality dimension and sub-criteria. According to the comparison result of 8 relevant experts with high involvement, the relative weight of each evaluation criterion can be got, thus establishing the Kansei Semantic priority in the Kansei Engineering's research. It can provide some references for the later modeling factors' selection.

The research framework is as follows: this chapter is the introduction; chapter two is the literature review on the factorial analysis, the analytic hierarchy process, and the fuzzy analytic hierarchy process; Chapter three is the theoretical background; in chapter four, the author takes minicar as the case study to verify the research methods; the last chapter is the summary of the whole paper.

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2 Literature Review

2.1 Kansei Engineering

Kansei is the personal subjective impression which gets from certain illusion, environments or situations. Human body's all senses organs are utilized in Kansei, including the vision, hearing, sense of touch, gustation and cognition [1]. Kansei Engineering is a technology which oriented by the customers and it commit itself to the new product's development process. It is based on ergonomics and computer science, which can transform the customer's psychological needs or emotion into the products' design factors. Kansei Engineering includes six types, which are Category Identification, Kansei Engineering System, Hybrid Kansei Engineering System, Kansei Engineering Modeling, Virtual Kansei Engineering, Collaborative Kansei Engineering Designing [2, 3]. In the Kansei Engineering method, expanding semantic attributes (SA) and products attributes' space is of great importance (Fig. 1) [4], especially the establishment of the semantic attributes (SA) is the first step of the Kansei design's success. In the previous researches, the final Kansei words are mostly got from the focused interviews or customers' scoring, thus getting highest score. Such kind of method is so easy to take. The purpose of this research is to adopt the factor analysis and combine with the fuzzy analytic hierarchy process to determine the method of optimal Kansei Vocabulary, thus assisting the designers more accurately to get to know the customers' inner heart and improving the Kansei meaning's accurate rate.

2.2 Factor Analysis

Factor analysis employs the thought of reducing dimensions; under the precondition of losing little information, many indexes can be transformed into several comprehensive

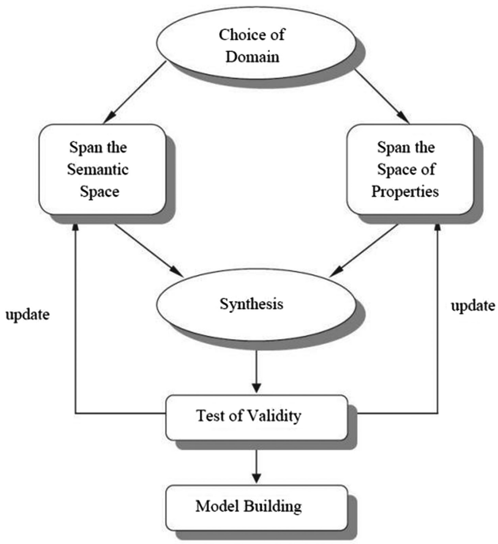

Fig. 1. Kansei engineering process (Sources: Schütte, 2002)

indexes. By making researches about the interior dependency relations of many indexes' correlation matrix, the author finds out all the variables' a few common factors and takes each target variable to indicate common factors' linear relation, thus representing the correlation between original variable and factors. The purpose of factor analysis is to seek the variables' basic structure, simplify the observation system and reduce the variables' dimensions, thus using a few variables to explain the complex problems in the research [5]. In the related fields of design, the main purpose of factor analysis is to find out many Kansei words and then carry out the grouping, thus getting the potential products' semantics which represents the maximum factors variables. Consequently, the evaluation criterion of the products style can be established, which is used for the following study. Yu-Ming Chang [6] through factor analysis extraction, three types of factors affecting consumer emotional perfection toward car steering wheels were identified: esthetic factors, operational strength factors and modernity factors. Chih-Fang Huang [7] by applying factor analysis extraction, 14 pairs of adjectives about China's melody intention are extracted, thus getting three intention factors. Qianru Qiu [8] in the design of name card, the factor analysis is applied to identify the five semantic groups and the extractive factors which uses the orthogonal rotation method, thus effectively distinguishing the original variables. Achmad Shergian [9] adopting the factor analysis is to divide the originality alarm clock's 8 Kansei adjectives into two main factors, thus meeting the demand of Kansei Engineering's utilization of mapping process to establish the correlation between Kansei intention and physical design elements. Simon Schütte [10] adopts the factor analysis to process the candy products' ordered correlation Kansei words in the AVI scale and get the 4 principle factors: attraction, lifestyle, familiarity and snacks.

2.3 Analytic Hierarchy Process

The Analytic Hierarchy Process is set up by the professor, Thomas L. Saaty of U.S.'s University of Pittsburgh in 1971. AHP is a simple, convenient, practical, multi-criteria decision-making analysis method, which is used to make quantitative analysis for the qualitative problems. It can simplify the complex questions into the systematic level elements and then make the comparative assessment of each two among the importance of level elements, thus obtaining the weighted value of each element and arranging the priority ordering of each project. Satty (1980) [11] points out that the application of AHP is quite wide and it can solve the following 12 kinds of problems: decision of priority ordering, schemes of alternation, decision of demand, resource allocation, scheme assessment, risk assessment, performance measurement, systematic design, guarantee of system stability, optimization issue, planning problem and conflict resolution. Guo-Niu Zhu [12] integrates the AHP and rough number at the early stage of designing concept assessment, thus disposing the subjectivity and fuzziness of experts' decisions. Li Li [13] adopts the AHP and entropy weight to evaluate the consumer's satisfaction degree for the customized products' development. Kwai-Sang Chin [14] integrates the innovative methods of AHP and Evidence Reasoning(ER), thus helping the manufacturers to deal with the uncertain problems of group decision-making in the early screening period of new products' development and design. Wang [15] applies the AHP to evaluate human's sensitivity to the colored light. Comparing the results of AHP and constant stimulus method indicates that AHP is a kind of effective method to evaluate the difference threshold values. Through the experience of telecommunication department's experts and the literature reviews, Gülfem Işıklar [16] applies the AHP to evaluate the mobile phones' options about users' preference order, thus establishing the relative weight of evaluation criteria.

However, The AHP is also easily affected by the extreme value; the establishment of hierarchical relation easily tends to be subjectivity. The interviewees probably can't get to know the problems which involved in all the hierarchies. Therefore, in accordance with this problem, this research applies the fuzzy theory with the combination of AHP to evaluate the experts group's opinions.

2.4 Fuzzy Analytic Hierarchy Process

The AHP cannot overcome the decision-making quality fuzziness issue. So in order to solve the differences between interviewees' subjection perception, evaluation and the group decision-making as well as solve the fuzziness issue, Laarhove and Pedrycz [17] lead the concept of fuzzy theory into the AHP, thus developing the FAHP.

The application of fuzzy theory and AHP's combination can effectively solve the problem of imprecise decision-making of experts. It utilizes the triangular fuzzy function to compare the original obtained values of each two and transform them into fuzzy number and membership function, and then take the triangular fuzzy function into comparative matrix. The fuzzy weighted value of each hierarchy can be worked out by the fuzzy operation and finally the experts' group opinions can be integrated, thus getting the final fuzzy weight. Selcuk Cebi and others [18] apply the FAHP to make sure the importance degree of car instrument panel's function demand. Jaemin Cho [19] applies the FAHP to distinguish the success factors in the early period of new products' commercialization process and analyze the elements which need to be given priority. H. Shidpour and others [20] applies the FAHP to evaluate the related important criterion and also establish the products' optimum structural design plan, assembling process and component suppliers. Ren Bin and others [21] applies the FAHP and multi-level matching algorithm, realizing the transition from the customers' demand model to the products' structure model and establishing the bridge between customer demand and products structure. Therefore, the feasibility design of demand-driven quick response is established. Mahdi Sabaghi and others [22] apply the FAHP and make combination with Shannon's entropy formula to set up the user interface's relative importance in the hierarchical structure's each element, thus promoting the continuity evaluation of different manufactured goods and process.

3 Theoretical Background

3.1 Fuzzy Sets, Triangular Fuzzy Numbers and Linguistic Terms

In 1965, the Fuzzy Set Theory was proposed in the journal of *Information and Control* by the professor L. A, Zadeh of University of California, Berkeley. Through 50-year expansion and evolution, the Fuzzy Sets Theory's theoretical framework and application technology become increasingly mature. One outstanding advantage of Fuzzy Set Theory is that it can preferably describe and imitate human's thinking mode and summarize and reflect human's feelings and experience, thus carrying out the fuzzy measurement, fuzzy recognition, fuzzy deduction, fuzzy control and fuzzy decision for the complex things and systems [23]. Triangular fuzzy membership function (as the Fig. 2) is used to describe certain fuzzy set's membership function of the whole domain X, which is to show the element X is the member of this fuzzy set's membership degree. And a, b, c are the parameters of real-value; x is the input variables. The most common triangle membership function is introduced as follows:

$$\mu_{\tilde{A}}(x) = \begin{cases} 0 & , if\ x \leq a \\ x - a/b - a & , if\ \ a \leq x \leq b \\ c - x/c - b & , if\ \ b \leq x \leq c \\ 0 & , if\ c \leq x \end{cases} \tag{1}$$

Linguistic term is proposed by Zadeh (1975), which uses the linguistic value to replace the definite value and takes the natural language to express the relation between the two criterions. It is beneficial for the experimental subjects to truly evaluate the objects. This research adopts 9 point linguistic values (Table 1) to distinguish the different degrees of emphasis. Its correspondent membership functions are from 0 to 1. If it is more important, its membership is closer to 1; if not, its membership is closer to 0.

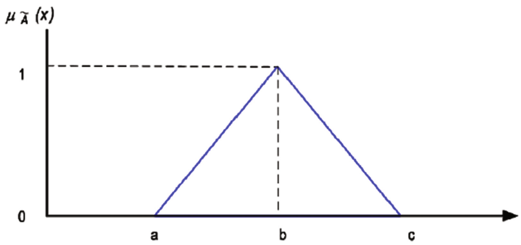

Fig. 2. Triangle membership function

Table 1. Semantic variables used in FAHP

Semantic value	Fuzzy number
Equally important	$\tilde{1}$ = (1,1,2)
Slightly important	$\tilde{3}$ = (2,3,4)
important	$\tilde{5}$ = (4,5,6)
Very important	$\tilde{7}$ = (6,7,8)
Extremely important	$\tilde{9}$ = (8,9,9)
Intermediate value inserted between two continuous dimensions	$\tilde{2}$ = (1,2,3); $\tilde{4}$ = (3,4,5); $\tilde{6}$ = (5,6,7); $\tilde{8}$ = (7,8,9)

3.2 Fuzzy Analytical Hierarchy Process and the Procedure

In combination with AHP, the fuzzy theory can transform the definite value into fuzzy number and membership function. The method of utilizing the triangle fuzzy number to take it into the comparative matrix can transform all the people's opinions into the fuzzy positive reciprocal matrix, thus solving the inaccuracy problem and developing the FAHP. This method is precise but the calculation is excessively complex [24].

This research establishes the semantic attribute's hierarchy framework in accordance with the obtained Kansei Vocabulary grouping after the factors analysis, thus calculating the related weight. The FAHP operation procedure is as follow:

After the paired comparison matrix, it will generate a matrix $i \times j$, matrix $\tilde{A} = [\tilde{a}_{ij}]$, and n is the number of the evaluation criterion.

$$A = [\tilde{a}_{ij}] = \begin{bmatrix} \tilde{a}_{11} & \tilde{a}_{12} & \cdots & \tilde{a}_{1j} \\ \tilde{a}_{21} & \tilde{a}_{22} & \cdots & \tilde{a}_{2j} \\ \vdots & \vdots & \vdots & \vdots \\ \tilde{a}_{i1} & \tilde{a}_{i2} & \cdots & \tilde{a}_{ij} \end{bmatrix}$$

Applying the geometric mean technology which proposed by Buckley (1985) can get each criterion's fuzzy geometric mean and fuzzy weight:

$$\tilde{r}_i = (\prod_{j=1}^{n} a_{ij})^{1/n} = (\tilde{a}_{i1} \otimes \tilde{a}_{i2} \otimes \cdots \otimes \tilde{a}_{in})^{1/n}, \quad (2)$$

$$\tilde{W}_i = \tilde{r}_i \otimes (\tilde{r}_1 \otimes \tilde{r}_2 \otimes \cdots \otimes \tilde{r}_n)^{-1}. \quad (3)$$

$$W = [\tilde{w}_a]_{1 \times n} = [\,\tilde{w}_1 \quad \tilde{w}_2 \quad \cdots \quad \tilde{w}_n\,], \text{ then } W^T \begin{bmatrix} \tilde{w}_1 \\ \tilde{w}_2 \\ \vdots \\ \tilde{w}_n \end{bmatrix}$$

$$S = A \otimes W^T \begin{bmatrix} \tilde{a}_{11} & \tilde{a}_{12} & \cdots & \tilde{a}_{1j} \\ \tilde{a}_{21} & \tilde{a}_{22} & \cdots & \tilde{a}_{2j} \\ \vdots & \vdots & \vdots & \vdots \\ \tilde{a}_{i1} & \tilde{a}_{i2} & \vdots & \tilde{a}_{ij} \end{bmatrix} \otimes \begin{bmatrix} \tilde{w}_1 \\ \tilde{w}_2 \\ \vdots \\ \tilde{w}_i \end{bmatrix}$$

$$= \begin{bmatrix} \tilde{a}_{11} \otimes \tilde{w}_1 \oplus \tilde{a}_{12} \otimes \tilde{w}_2 \oplus \cdots \tilde{a}_{1j} \otimes \tilde{w}_n \\ \tilde{a}_{21} \otimes \tilde{w}_1 \oplus \tilde{a}_{22} \otimes \tilde{w}_2 \oplus \cdots \tilde{a}_{2j} \otimes \tilde{w}_n \\ \vdots \\ \tilde{a}_{i1} \otimes \tilde{w}_1 \oplus \tilde{a}_{i2} \otimes \tilde{w}_2 \oplus \cdots \tilde{a}_{ij} \otimes \tilde{w}_n \end{bmatrix} \quad (4)$$

$$= \begin{bmatrix} \tilde{s}_1 \\ \tilde{s}_2 \\ \vdots \\ \tilde{s}_i \end{bmatrix}$$

$$\lambda_{\max} = \frac{1}{n}\left(\frac{\tilde{s}_1}{w_1} + \frac{\tilde{s}_2}{w_2} + \cdots \frac{\tilde{s}_i}{w_i}\right)$$

$\tilde{w}_i$ is the relative importance of No.i evaluation criterion; $\tilde{a}_{ij}$ is the relative importance of No. i evaluation criterion corresponding to No.j evaluation criterion $\lambda_{\max}$ is the maximum eigenvalue of the matrix function.

Calculate *CI* and *CR* at the same time and then carry out the consistency check.

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (5)$$

Table 2. *RI* value

n	1	2	3	4	5	6	7	8	9	10	11
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

$CR = CI/RI$, *RI*'s value is showed in Table 2 (Satty 1980)

If $CR \leq 0.1$, the paired comparison data $\tilde{A}$ is reasonable and consistent and the output result of relative weight is W_i; if $CR > 0.1$, the paired comparison data $\tilde{A}$ is inconsistent, which needs to be repeated the paired comparison experiment.

4 Case Study

In the Kansei Engineering's research method, the primary step is to extract specific products' Kansei intention. Therefore, selecting the products' semantic factors which can satisfy the customers' requirement seems to be extremely important, which also has the direct bearing on the mapping products' form element. In this research, the author takes the minicar as the experimental subject and makes research that the procedure can be divided into two stages: the first stage uses the factors analysis to group the 18 Kansei adjectives into 4 main factors; the second stage is to adopt the FAHP to work out the relative weight of customers' evaluation Kansei meaning. Such a systematic procedure can help the designers and relevant manufactures to make sure the customers' real emotional appeals.

4.1 Stage One: Extract Product Image

Semantic Screening. Expanding products' semantic attributes and property space are two important constituent parts for elaborating the products field. This research has widely made survey on minicar's relevant journals, magazines, networks, thus getting 50 Image-word. In order to avoid the Kansei meaning so similar that the experimental process is complex, 5 graduate students with industrial design major make up a focus group and make comparison of the 50 adjectives. Finally they extract 18 relevant adjectives which have the high correlation with the minicar's perceptual cognition level (concise, free, leisure, smooth, lively, romantic, transparent, curvilinear, enthusiastic, strong, practical, rounded, vigorous, feminine, eye-catching, harmonious, luxurious, and wild).

30 experimental subjects who have the design background uses the Likert scale to mark the 18 screened products' Kansei meaning. If people think that this Kansei meaning really accords with people's minicar emotion in their heart, they can mark 5 points; if the coincidence degree is at an average level, people can mark 1 point. Finally the formed 18×30 matrix date will be imported into the SPSS software and then carry out the factors analysis. Then the author uses the maximum variance method to rotate each factor, and then get the following rotation composition matrix (Table 3)

Result. In the explanatory total variance result, four main factors are got by taking the initial eigenvalue which is greater than 1 as the criteria: the factor 1 is the modern factor, including concise, leisure, and smooth, harmonious, lively; factor 2 is the attractive factor, including practical, rounded, romantic, and transparent, curvilinear and enthusiastic; factor 3 is the elegant factor, including vigorous, feminine, free, and eye-catching; factor 4 is the dynamic factor, including luxurious, wild and strong. The factor analysis result shows that the 18 Kansei adjectives variables' four factors accounts for 73.746% of the total variables.

4.2 Stage Two: Weight of Measuring Criterion

Hierarchy Framework. The core of FAHP is to set up the hierarchy framework. This research is divided into three hierarchies: objective hierarchy, criterion hierarchy and sub-criteria hierarchy. The objective hierarchy is defined as the minicar's kansei semantic choice; the criterion hierarchy is defined as modern factor, attractive factor, elegant factor and dynamic factor. The sub-criteria hierarchy is defined as 18 Kansei adjectives (Fig. 3).

Table 3. Factor analysis results for the 18 image-words

Image-word	Factor 1 modern-style	Factor 2 attractive-style	Factor 3 elegant-style	Factor 4 dynamic-style
Concise	0.820	0.260	0.223	0.275
Leisure	0.737	0.275	0.487	−0.108
Smooth	0.664	0.425	0.231	0.304
Harmonious	0.922	0.075	0.120	0.077
Lively	0.759	0.339	0.350	0.086
Practical	0.209	0.595	0.560	−0.142
Rounded	0.432	0.745	−0.105	−0.075
Romantic	0.344	0.664	0.154	0.288
Transparent	0.264	0.710	0.051	0.280
Curvilinear	0.039	0.772	0.273	0.304
Enthusiastic	0.162	0.816	0.128	0.223
Vigorous	0.524	0.442	0.536	0.291
Feminine	0.273	−0.058	0.725	−0.002
Free	0.490	0.259	0.644	0.124
Eye-catching	0.208	0.323	0.537	0.421
Luxurious	−0.048	0.315	−0.021	0.597
Wild	0.231	0.016	0.198	0.844
Strong	0.222	0.387	−0.405	0.568
Total	8.636	2.211	1.294	1.133
Variance(%)	47.977	12.285	7.189	6.295
Cumulative(%)	47.977	60.262	67.450	73.746

Evaluation value after calculating and integrating the group's opinions. After getting each expert's paired comparison value, the expert's fuzzy positive reciprocal matrix is set up. Then the matrix's original accurate value a_{ij} is transformed into $\tilde{a}_{ij} = (a_{ijl}, a_{ij}, a_{iju})$ in accordance with the semantic value. Each expert's relative importance evaluation value for No.i and No.j items is a_{ij}. The triangle fuzzy number will transform a_{ij} into three numbers, a_{ijl}, a_{ij} and a_{iju}; the a_{ijl} represents the experts evaluation minimum value of item i to j's comparative judgment.a_{iju} represents the experts evaluation's maximum value. The following takes the first expert evaluation's attractive factor, subset P1 as an example:

$$P1 = \begin{bmatrix} 1 & (7,8,9) & (8,9,9) & (1,2,3) & (1,1,2) & (4,5,6) \\ (0.111,0.125,0.1429) & 1 & (0.333,0.5,1) & (0.2,0.25,0.333) & (0.125,0.1429,0.1667) & (0.2,0.25,0.333) \\ (0.111,0.111,0.125) & (1,2,3) & 1 & (0.333,0.5,1) & (0.111,0.125,0.1429) & (3,4,5) \\ (0.333,0.5,1) & (3,4,5) & (1,2,3) & 1 & (0.2,0.25,0.333) & (4,5,6) \\ (0.5,1,1) & (6,7,8) & (7,8,9) & (3,4,5) & 1 & (6,7,8) \\ (0.1667,0.2,0.25) & (3,4,5) & (0.2,0.25,0.333) & (0.1667,0.2,0.25) & (0.125,0.1429,0.1667) & 1 \end{bmatrix}$$

In order to get each criterion's fuzzy weight, the formula (2) should be used to get each line's geometric mean. The following is the value of calculating $\tilde{Z}_i$:

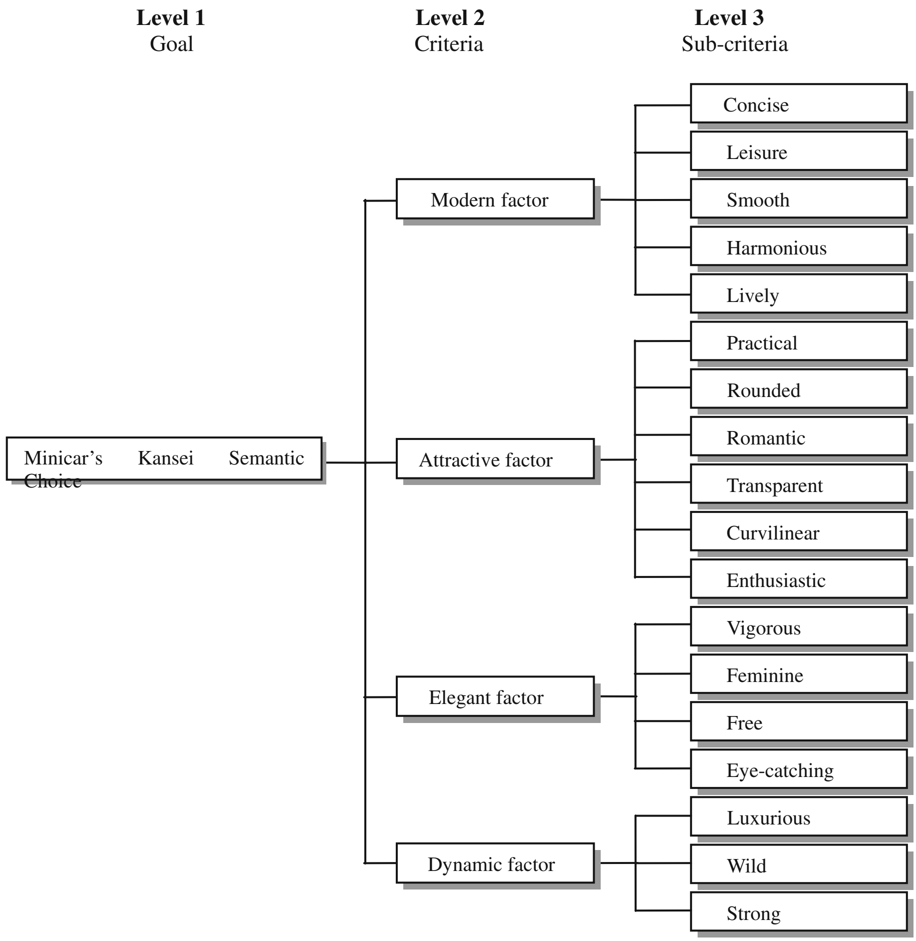

Fig. 3. The hierarchy framework of minicar's Kansei semantic choice

$$\tilde{Z}_1 = (2.4644,\ 2.9938,\ 4.4246)$$
$$\tilde{Z}_2 = (0.2387,\ 0.2806,\ 0.4175)$$
$$\tilde{Z}_3 = (0.4807,\ 0.6177,\ 0.9012)$$
$$\tilde{Z}_4 = (0.9635,\ 1.3077,\ 1.9786)$$
$$\tilde{Z}_5 = (2.6889,\ 3.4085,\ 4.2339)$$
$$\tilde{Z}_6 = (0.3574,\ 0.4228,\ 0.4533)$$

According to formula (3), each criterion's fuzzy weight can be got:

$$\tilde{W}_1 = (0.2016,\ 0.3314,\ 0.5898)$$
$$\tilde{W}_2 = (0.0195,\ 0.0311,\ 0.0580)$$
$$\tilde{W}_3 = (0.0393,\ 0.0684,\ 0.1253)$$
$$\tilde{W}_4 = (0.0788,\ 0.1448,\ 0.2750)$$
$$\tilde{W}_5 = (0.2200,\ 0.3773,\ 0.5885)$$
$$\tilde{W}_6 = (0.0292,\ 0.0468,\ 0.0630)$$

In order to get each criterion's optimum defuzzification value, each defuzzification value can be worked out in accordance with the centroid method. And the normalization method can be applied to get the relative weight; P1's defuzzification matrix DF_{P1} and the normalization value NW_{P1} are as follows:

$$DF_{P1} = \begin{bmatrix} 0.3743 \\ 0.0362 \\ 0.0777 \\ 0.1662 \\ 0.3953 \\ 0.0463 \end{bmatrix} \quad NW_{P1} = \begin{bmatrix} 0.3145 \\ 0.0330 \\ 0.0709 \\ 0.1516 \\ 0.3607 \\ 0.0422 \end{bmatrix}$$

Adopting the above same steps can get 8 experts' fuzzy weight for each evaluation criterion, integration expert's weight and normalization relative weight (Table 4).

Result. According to FAHP's calculation result, in the classification of 18 Kansei words, the modern factor has the highest relative weight, which is 0.4167; the second one is elegant factor, which is 0.2824; the following one is attractive factor, which is 0.2798; the last one is the dynamic factor, which is 0.1789. In the classification of sub-criteria, the relative weight of "eye-catching" under the elegant factor quality dimension is 0.1171. It is the most important emotion among the customers' all Kansei words, which indicates that the customer has a favorable impression on the eye-catching car's appearance molding when they purchase the minicar. The designers should attach great importance to the cognition of eye-catching car's appearance molding in the automobile form design. The second one is the Kansei meaning of modern factor's smooth, which indicates that the customers have a high expectation for the concise auto-body modeling. In the modern factor, the "smooth" automobile language which ranks third is also welcomed by the customers. In the attractive factor, curvilinear minicar's appearance has the highest relative weight. In dynamic factor, the luxurious Kansei words get the highest mark. To sum up, in order to satisfy the wide customers' emotional needs, the relevant manufacturers and products designers should choose to design the concise and smooth minicars. They should make the modeling creativity with a certain objective after determining the perceptual cognition (Table 5).

Table 4. 8 experts' weight value for each evaluation criterion

Modern factor	P1	P2	P3	P4	P5	P6	P7	P8	Normalized weight
Concise	0.2955	0.0923	0.5227	0.2034	0.5518	0.2432	0.0344	0.3031	0.2613
Leisure	0.1116	0.0394	0.0600	0.2015	0.0565	0.1117	0.0874	0.1603	0.1122
Smooth	0.3773	0.1795	0.1899	0.1372	0.1133	0.1050	0.2506	0.3933	0.2400
Harmonious	0.0545	0.5425	0.1926	0.0391	0.0810	0.4394	0.4247	0.0773	0.1853
Lively	0.1611	0.1456	0.1926	0.4188	0.1975	0.1007	0.2030	0.0660	0.2012
Attractive factor	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**Normalized weight**
Practical	0.3145	0.1342	0.2448	0.1081	0.3514	0.2034	0.0641	0.0277	0.1647
Rounded	0.0330	0.0584	0.0649	0.0774	0.0179	0.0842	0.1759	0.1057	0.0753
Romantic	0.0709	0.0827	0.2006	0.4481	0.1815	0.1176	0.1204	0.1409	0.1709
Transparent	0.1516	0.2758	0.1584	0.0420	0.0683	0.275	0.0633	0.3615	0.1612
Curvilinear	0.3607	0.4121	0.2821	0.1517	0.3226	0.1791	0.3999	0.2519	0.3302
Enthusiastic	0.0422	0.0367	0.0493	0.1728	0.0583	0.1421	0.1763	0.1123	0.0976
Elegant factor	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**Normalized weight**
Vigorous	0.1974	0.1177	0.2106	0.1525	0.1728	0.2425	0.0713	0.0831	0.1683
Feminine	0.0376	0.4594	0.1139	0.1104	0.0386	0.1169	0.0591	0.1521	0.1150
Free	0.2623	0.0700	0.5284	0.1937	0.2022	0.5132	0.4116	0.2488	0.3022
Eye-catching	0.5027	0.3529	0.1471	0.5433	0.5864	0.1274	0.4580	0.5160	0.4145
Dynamic factor	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**Normalized weight**
Luxurious	0.1237	0.7682	0.3726	0.2405	0.7562	0.4034	0.4519	0.5004	0.4935
Wild	0.1100	0.1080	0.3137	0.6948	0.1157	0.4934	0.4926	0.4390	0.3429
Strong	0.7662	0.1238	0.3137	0.0647	0.1281	0.1032	0.0555	0.0606	0.1636

Table 5. Relative weight analysis table of minicar's each quality factors

Quality dimension	Weight	Sub-criteria	Weight	Relative weight	Order
Modern factor	0.4167	concise	0.2613	0.1089	2
		Leisure	0.1122	0.0468	12
		Smooth	0.2400	0.1000	3
		Harmonious	0.1853	0.0772	8
		Lively	0.2012	0.0838	7
Attractive factor	0.2798	Practical	0.1647	0.0461	13
		Rounded	0.0753	0.0211	18
		Romantic	0.1709	0.0478	10
		Transparent	0.1612	0.0451	14
		Curvilinear	0.3302	0.0924	4
		Enthusiastic	0.0976	0.0273	17
Elegant factor	0.2824	Vigorous	0.1683	0.0475	11
		Feminine	0.1150	0.0325	15
		Free	0.3022	0.0853	6
		Eye-catching	0.4145	0.1171	1
Dynamic factor	0.1789	Luxurious	0.4935	0.0883	5
		Wild	0.3429	0.0617	9
		Strong	0.1636	0.0293	16

5 Conclusion

In the research of Kansei Engineering, it is very important to extract customers' emotional needs in the specific products. Kansei image is directly related to the modeling factors' choice. In this paper, the author proposes a kind method which combines the factors analysis and fuzzy analytic hierarchy process to extract the products' high correlation meaning, thus leading a direction for the designers' modeling creativity. The minicar is taken as the object in this paper, finding that the modern factors of "concise" and "smooth" are most easily to attract the customer's inner heart, thus causing the customers' emotional resonance. Meanwhile, the research method can be applied into other industrial products' design.

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