ANALYSIS OF FEATURES OF AN UNIQUE EVALUATION POINT AND ITS COMMON RECOGNITION IN THE SENSORY EVALUATION

Estimation of Impression in Designing (1)

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Abstract: An original technique for design based on the combination of human thought and statistical handling of evaluation is described. The unique evaluation point by which the commercial goods were characterized was analyzed using the knives specially designed from the view point of preciseness. Then the relation between the features of the unique point and common recognition of the impression was discussed. The impression of samples was sensory evaluated using a scale composed of several estimation items. The distribution diagram of data was described and a sample which locates in an unique position in the diagram was selected and called a sample of the singularity. The feature of impression for the singularity sample was analyzed by means of the statistical method. An improved sample emphasized the feature was newly designed, and was sensory evaluated with the same set of evaluation scale. Repetition of this process will make surer in respect of the recognition of the impression for the design

Keywords: Common recognition of impression, Design method, Semantic differential method, Singularity point, Knife, Sensory evaluation

1. INTRODUCTION

The commercial goods with which consumers feel “joy” and “availability of technology and science” will become important in the next new century. Therefore, it is necessary to convert the policy of the design for attaining higher productivity into that for emphasizing the consumer preference based on the sensory evaluation.

The authors have studied on the fundamental approach of designing and sensory evaluation, and have reported that not statistical mean values but an unique evaluation point of sensory evaluation should be used in designing. In the present study, the unique evaluation point by which the commercial goods were characterized was analyzed using the knives specially designed from the view point of preciseness. Then we tried to investigate the relation between the features of the unique point and common recognition of the impression.

Many works have been reported on the designing using statistical methods by Japanese authors such as N. Mori, K. Sugiyama, M. Watanabe, T. Yamanaka, K. Onai and K. Inoue and these works are introduced in the book edited by N. Mori [1]. However, these authors did not deal with the unique evaluation points described in this report.

2. EXPERIMENTAL

2.1 Samples

Ten knives specially designed for this investigation by the Japan Soc. of Precision Engineering Subcommittee and three typical knives commercially available were used in this study.

Both the real knife samples and their images made by 3D-CG were used for evaluation. The correlation between evaluation scores for real knife samples and for 3D-CG images was confirmed. Figure 1 shows the knife images by 3D-CG.

2.2 Procedure for analysis

The total process for this investigation is briefly described below.

1. The impression of many existing representative samples is sensory evaluated using a scale composed of several estimation items. The distribution diagram of data is described, and a sample which locates in an unique position in the figure is selected and called a sample of the singularity. The singularity sample at the unique point is considered to give certain different psychological impression to persons.

2. The feature of impression for the singularity sample is analyzed by means of statistical method. Then, sever-
Sample A-J were specially designed by the committee
Sample I-III were commercial goods.

Figure 1: Knife samples

3. RESULTS AND DISCUSSION

3.1 Structure analysis of semantic space for precision instruments.

Each knife sample with the common feeling which the precision instruments have was designed by the committee as a model [2]. In this paper, the authors call the common feeling as "precision feeling".

The analysis of the semantic space of "precision feeling" was carried out by using the semantic differential (SD) method [3] as described below.

The 136 words of terminology which concerned with the "precision feeling" were collected, and were classified into 44 representative terminology groups (concepts). Then 68 persons, who were 60 male students and 8 female students, evaluated these concepts using a scale composed of 17 sets of the adjective pair. The semantic space was decided by the factor analysis. Five factors with 83% accumulation contribution ratio were obtained by the means of principal component analysis with a Varimax rotation using a SPSS statistical software.

3.2 Preparation of evaluation sheets for knives

Evaluation sheets for knife samples were prepared as follows. Fifty-three words were chosen from the

### Table 1: Factor axis score

* Score value defined in this study
** Mean value of commercial goods

<table>
<thead>
<tr>
<th>Factor</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample A</td>
<td>4.61</td>
<td>4.69</td>
<td>4.64</td>
<td>4.42</td>
<td>4.83</td>
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<tr>
<td>Sample B</td>
<td>4.65</td>
<td>4.98</td>
<td>4.75</td>
<td>4.67</td>
<td>4.57</td>
</tr>
<tr>
<td>Sample C</td>
<td>4.06</td>
<td>4.43</td>
<td>4.51</td>
<td>3.80</td>
<td>3.94</td>
</tr>
<tr>
<td>Sample D</td>
<td>3.17</td>
<td>3.90</td>
<td>3.86</td>
<td>3.25</td>
<td>3.82</td>
</tr>
<tr>
<td>Sample E</td>
<td>4.73</td>
<td>5.04</td>
<td>4.97</td>
<td>4.53</td>
<td>4.57</td>
</tr>
<tr>
<td>Sample F</td>
<td>4.39</td>
<td>4.70</td>
<td>4.50</td>
<td>4.96</td>
<td>4.61</td>
</tr>
<tr>
<td>Sample G</td>
<td>4.20</td>
<td>4.76</td>
<td>4.59</td>
<td>4.13</td>
<td>4.40</td>
</tr>
<tr>
<td>Sample H</td>
<td>4.61</td>
<td>4.67</td>
<td>4.69</td>
<td>4.99</td>
<td>4.53</td>
</tr>
<tr>
<td>Sample I</td>
<td>4.54</td>
<td>4.44</td>
<td>4.55</td>
<td>4.26</td>
<td>3.85</td>
</tr>
<tr>
<td>Sample J</td>
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<td>4.13</td>
<td>4.08</td>
<td>3.67</td>
<td>3.87</td>
</tr>
<tr>
<td>Sample I</td>
<td>3.77</td>
<td>3.74</td>
<td>3.70</td>
<td>4.11</td>
<td>4.03</td>
</tr>
<tr>
<td>Sample II</td>
<td>4.40</td>
<td>3.97</td>
<td>4.06</td>
<td>4.30</td>
<td>4.01</td>
</tr>
<tr>
<td>Sample III</td>
<td>4.41</td>
<td>3.90</td>
<td>4.02</td>
<td>4.48</td>
<td>4.25</td>
</tr>
<tr>
<td>Mean value</td>
<td><strong>4.19</strong></td>
<td><strong>3.87</strong></td>
<td><strong>3.93</strong></td>
<td><strong>4.30</strong></td>
<td><strong>4.10</strong></td>
</tr>
</tbody>
</table>
Figure 2: Factor axis score diagram of existing samples

3.3 Comparison of evaluation score between the real sample and its image

By using the 3D-CG software, each image of 13 knife samples was described on the CRT. Twenty-four persons, who were 12 male students and 12 female students, were sensory evaluated each of the images and real samples using the evaluation sheets. The correlation coefficient between both evaluated values on each sample was over 0.8 in almost all samples. (See Table 2 on next page) It was confirmed that there was negligible difference in the both results so that the CRT images with the advantages of time and cost for preparation were thereafter used instead of the real sample.

3.4 The factor axis score and the score distribution diagram

Each score of the image sample was assigned to 5 factors of the precision feeling structure. The authors call the evaluated score as "the factor axis score" in this report.

The scores were calculated by the next equation.

\[ S = \frac{a}{bc} \]

Here, \( S \) shows the value of factor axis score, \( a \) is the sum of evaluation score concerning each factor by all persons evaluated, \( b \) is number items concerning to each factor, and \( c \) is number of persons evaluated.

The assignment of each adjective pair to the 5 factors was carried out by 10 students using KJ method. The results is shown in Table 3. Open circles indicate related factors. The results of factor axis score are shown in Table 27.
Table 2: Correlation coefficients between evaluated values of real samples and that of images on Table 3: Assignment of evaluation items to factors

<table>
<thead>
<tr>
<th>Sample</th>
<th>Cor. Coef.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SampleA</td>
<td>0.711</td>
</tr>
<tr>
<td>SampleB</td>
<td>0.768</td>
</tr>
<tr>
<td>SampleC</td>
<td>0.880</td>
</tr>
<tr>
<td>SampleD</td>
<td>0.878</td>
</tr>
<tr>
<td>SampleE</td>
<td>0.891</td>
</tr>
<tr>
<td>SampleF</td>
<td>0.862</td>
</tr>
<tr>
<td>SampleG</td>
<td>0.829</td>
</tr>
<tr>
<td>SampleH</td>
<td>0.875</td>
</tr>
<tr>
<td>SampleI</td>
<td>0.835</td>
</tr>
<tr>
<td>SampleJ</td>
<td>0.811</td>
</tr>
<tr>
<td>SampleI</td>
<td>0.822</td>
</tr>
<tr>
<td>SampleII</td>
<td>0.839</td>
</tr>
<tr>
<td>SampleIII</td>
<td>0.902</td>
</tr>
</tbody>
</table>

3.5 Decision of the singularity point

In Fig. 2, points A-J correspond to the knives designed by the committee of the Japan Soc. of Precision Engineering Subcommittee, and points I, II and III to three marketing knives of the different size, and point p represents the mean value of marketing knife samples. The points for the samples designed by the subcommittee show the dispersed score distribution in comparison with those of the commercial products.

The position of sample E in Fig. 2 is the highest on both axes of functionality and sensitivity, therefore, it is considered that the position of the sample E is a singularity point.

In other 9 factor axis score diagrams (Fig. 7a-7i) corresponding to Figure 2, Sample A, E and H locate in higher position in both horizontal and vertical axes. Especially, Sample E locates in the 7 diagrams of Figs. 7-a,d,e,f,g,h and Figure 2.

Because of the reason described above, the sample E was decided as the sample showing the singularity.

3.6 Feature analysis of the singularity

In order to investigate the features of sample E, the difference in evaluated score between sample E and the 3 marketing samples by the mean value was analyzed on each evaluation item. The results are shown in Fig. 3. The vertical axis of the figure shows score value. In this experiment, the differences were calculated on all adjective pair items. The significance of
3.7 Designing of the new knife

Several knife samples were newly designed by students after the feature analysis on the singularity of sample E. These new samples of K, L and M were shown in Fig. 4. The new samples were designed on the CRT, taking account of the two items of “shone” and “sharp” in Sample K, “smooth” and “clean” in Sample L, and “modern” and “skillful” in Sample M respectively, corresponding to the student’s aims for the design.

3.8 Evaluation of the new samples

Evaluation of sample K, L and M was carried out by the same persons using the same evaluation sheets as described above. Data of these samples were plotted in the similar diagram as Fig. 2. The results were shown in Fig. 5.

It was confirmed by Fig. 5 that the position where sample K locates is more desirable than that of sample E. However, the lower positions, and hence the undesirable evaluations, were found for samples L and M in the diagram.

The statistical difference in evaluated score between newly designed sample K or L and singularity sample E was examined. For each evaluation item, it was checked whether the singularity of sample E was emphasized or not. It is shown in Fig. 6-a that the evaluation for sample K is superior to that for sample E. On the contrary, Fig. 6-b shows inferiority of sample L comparing with sample E. Thus it was proven that sample K exceeds sample E in the score for many items.

In Fig. 6a and Fig. 6b, the difference was calculated on all items, and the items in which the difference was neg-
Figure 6a:
Difference of evaluated values between Sample K and Sample E in various estimation items.
Plus score shows Sample K is superior to E in the sensory evaluation item.

Figure 6b:
Difference of evaluated values between Sample L and Sample E in various estimation items.
Minus score shows Sample K is inferior to E in the sensory evaluation item.
Figure 7-a:  
horizontal axis: functionality  
vertical axis: familiarity

Figure 7-b:  
horizontal axis: functionality  
vertical axis: potency

Figure 7-c:  
horizontal axis: functionality  
vertical axis: activity

Figure 7-d:  
horizontal axis: sensitivity  
vertical axis: familiarity

Figure 7-e:  
horizontal axis: sensitivity  
vertical axis: potency

Figure 7-f:  
horizontal axis: sensitivity  
vertical axis: activity

Figure 7-g:  
horizontal axis: familiarity  
vertical axis: potency

Figure 7-h:  
horizontal axis: familiarity  
vertical axis: activity

Figure 7-i:  
horizontal axis: potency  
vertical axis: activity

Figure 7-a-i: Factor axis score diagram of existing samples  
(Each diagram corresponds to Figure 2.)
4 CONCLUSION

The technique for estimation of impression described above is characteristic in respect of the following.

1) The impression of certain design is shown by not statistical mean value of the evaluation by many people, but the singularity of the design in semantic space. This process seems to make the common recognition of the evaluation on features of impression by many people.

2) The difference between the evaluated score of the design at the singularity point and the mean value of the evaluation for the current design is statistically examined. The difference seems to be related to the factors of the impression of the design.

3) By evaluating the new design using the same technique, it is possible to know whether the aim emphasizing the items of the analyzed factors is desirably achieved.

4) Repetition of this process will make surer in respect of the recognition of the impression for the design.

5) This technique is a original method based on the combination of human thought and statistical handling of the evaluation. It is a support process for designing which the human consistently does and not for the mechanization of the design.

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