A KANSEI ENGINEERING APPROACH TO DESIGN A SCISSORS

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ABSTRACT

In today's business environments, where quality of a product is an essential part of design process, psychological needs for emotional satisfaction are growing. Kansei engineering, as a kind of human ergonomic technology refers to the translation of the psychological consumers feeling about a product related to perception in design. Kansei engineering sometimes referred to as emotional design. Since our study is an experimental study, the second level of emotional design (behavioral) was considered in Kansei engineering for designing scissors as a product. 32 Kansei words and 10 different types of scissors as samples for this study with the aspect of being in touch and variety in use were selected. A unique and standard paper cutting form that was sketched was used in tests, and participants must follow the path without break. 7-grade semantic differential method gathered in questionnaire. Each user had 10 of that and should fill it after working with each scissors and cutting that form. 36 university students had participated. Product details had been identified to finally connect to each adjective. Received data were analyzed and correlation coefficient of each couple adjectives was estimated. Kansei words classified in 13 clusters, and each cluster connected to related product details and design elements identified. Top scissors in each clusters were the same with a few replacements and that was a delicate scissors that may be selected because of delicate material and cutting the complicated path. Finally using the result of this study we present a new scissors designed.

Keywords: Product design, Kansei engineering, Scissors, Industrial design

1. INTRODUCTION

Product design is a problem-solving activity, whose purpose is to develop a successful product fitting consumers' needs. To achieve this goal, systematic methods have been used by designers to obtain an optimal solution through the process of data collection, analysis, synthesis and decision-making [6,8]. Nowadays the consumers have a lot of goods at home

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and they want to have goods more needed, attractive and very sensitive to their personality [12]. In proportion to the satisfaction of basic requirements, customers yearn not only for goods that satisfy their physical requirements, but also those which are valuable to their desire and would fulfill their psychological needs such as feeling and emotion. With this in mind, product design concept has shifted from manufacturer-oriented to customer-oriented [14]. Mainly products have two main properties. One is the basic function of the product which is determined by quality, capacity, and performance satisfying the customer's basic requirements. The other is the subsidiary function of the product which is imported by shape, style, and color appealing to the customer's mind [14]. The analysis of users perception have been traditionally studied using market research techniques in which users participate only as an evaluation source (and not as requirements generator), and products are evaluated and then redesigned if deemed necessary [2]. The feelings and the needs of the consumers are identified like crucial values for manufacturers. The human brain carries out mainly two kinds of information process, the intelligence process and the Kansei process. Kansei is employed for the test or the semantic evaluation in various fields to consider the human feelings. The Japanese word, Kansei has the significance of feeling, impression and/or emotion [9,11]. Kansei engineering, as a kind of human ergonomic technology [14] refers to the translation of the psychological consumers feeling about a product related to perception in design [11]. According to Norman [1] emotional design has three levels: a) visceral (as when you call something pretty), b) behavioral (emphasizes the use of objects), and c) reflective (considers user's thinking about product like prestige, etc.). It should be noted that Kansei Engineering, (sometimes referred to as "emotional design" [2]) can have these three levels. Since our research is an experimental study, the second level of emotional design (behavioral) was considered in our study. The purpose of this study is designing scissors as a product using Kansei engineering methodology. To this aim the current study has been tried to collect most of the pleasant factors of different scissors with different usability in a new product which can act as a general scissors.

2. MATERIAL & METHODS

2.1. Kansei engineering methodology

Nagamachi [12] explains Kansei engineering type 1 that it starts from decision of product strategy as design domain as well as the target. We collect the Kansei words related to the product domain. Usually 30-40 Kansei words, adjectives or sentences of feeling, and construct 5-point or 7-point Semantic Differentials (SD) scale are used in this method. We collect the product samples, and identify item/category of each sample. The item means a category like size, width, color, style, function, etc., and the category implies more detail features, like red, yellow, green, and blue for color item [12]. 36 peoples (22 females and 14 males) voluntary had participated and all subjects were bachelor students of industrial design.

2.1.1. Collection of Kansei words

Users present their desires by abstract adjectives [14]. So, here Kansei engineering method started with collecting 150 Kansei words for scissors, then among these words 32 Kansei words were selected to use in this research. The Semantic Differential method developed by Osgood [14] is a typical procedure for getting meaning space from well-prepared samples by

investigation of the numerical mapping relationship between the samples and the related words. It uses numerical scales such as 5-grade or 7-grade serial numbers for evaluation measure. In our study Kansei words with 7-grade SD method results in questionnaire that each had been used. It should be noted that each subject was asked to fill the questionnaire after working with each scissors. Figure 1 and table 1 shows the questionnaire and selected Kansei words.

Kansei word

Not at all ☐☐☐☐☐☐☐ Very much

Figure 1: Seven point scale used in this study

Table 1: Selected Kansei words

Sharp	High class	Usable	Admired for all
Pleasant sound	Match	Portable	Digestible
Beautiful	Special	Accurate	Flowing
Good grip	Good material	Powerful	Graceful
Dangerous	Shiny	Delicate	Physically tiresome
Small	Two sided	Resistant	Boring appearance
Tormenting	Decorative	Thick	Proficiency
Blunt	Funny	Tight	Colorful

2.1.2. Identifying cutting form

For working with scissors, a standard and unique form was needed to cut. The form that showed in figure 2 was designed that has all straight, zigzag, cursive, repeated curve lines, and users must cut from the start point and follow the path without break. The form was printed to paper A5 size. Here as mentioned because of limitations of research only papers were cut, and if other materials were used the result may be changed.
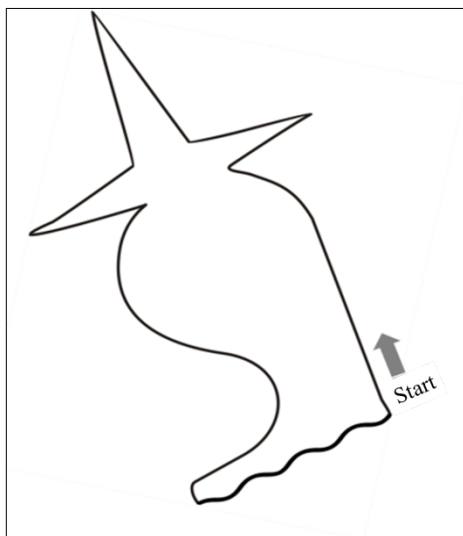

Figure 2: Cutting form (size of paper: A5)

Figure 3: Collected 10 types of scissors

2.1.3. Collection of product samples

Scissors with the aspect of being in touch and variety in use had chosen and each scissors got a letter mark as its type. Each user must check that which type of scissors is he/she using. Each questionnaire must show that which scissors is about. Figure 3 shows collected samples. Scissors' variety of use would give us the opportunity to collect more pleasurable and usable factors.

2.1.4. Identifying product category

Here product details must be identified to finally connect to each adjective or group of adjectives. For this reason, all product body divided in three parts: 1) handle, 2) blade, and 3) hinge. Details of these three parts separately presented in figure 4 were identified and here these details that can effect on each adjective are.
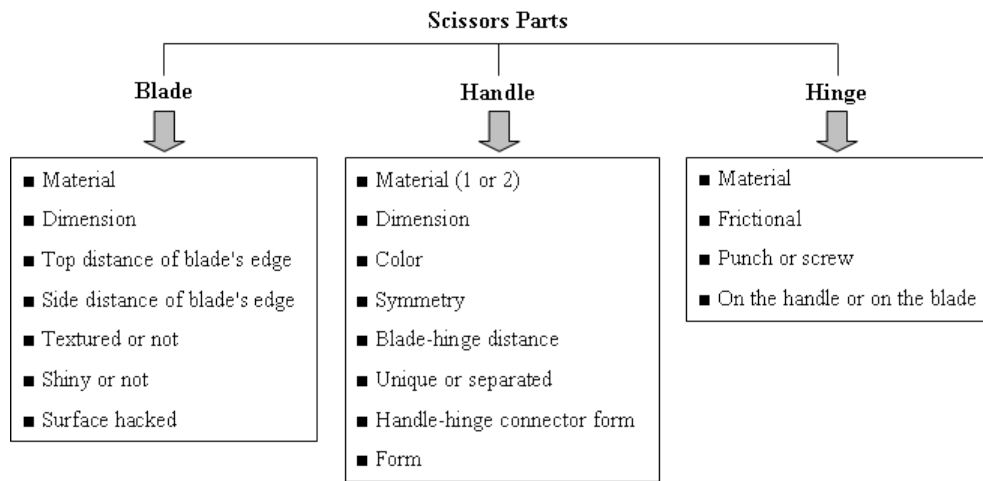

Figure 4: Product (scissors) category and details

2.2. Data analysis

All data was analyzed by finding each type of scissors' average of scores for each Kansei word. These averages were identified as each scissors score for each Kansei word in final table. Then chart of these scores, for comparison of each type of scissors and comparison of all scissors together, had been made for better view of received data. After these comparisons, correlation coefficients of each couple Kansei words were estimated to find numerical correlations among these words. Then by the result, adjectives had been classified via closing to each other according to more numerical correlation. With this classification cluster analysis which could classify words in some clusters had been done. Finally each cluster, according to have meaningful correlations between adjectives in it, connected to those categories which had effect on, and design elements had found. The correlation coefficient ρX, Y between two random variables X and Y with expected value μX and μY and standard deviations σX and σY is defined as:

$$\rho_{X,Y} = \frac{\text{cov}(X,Y)}{\sigma_X \sigma_Y} = \frac{E((X - \mu_X)(Y - \mu_Y))}{\sigma_X \sigma_Y},$$

where *E* is the expected value operator and *cov* means covariance. A widely used alternative notation is:

$$\text{corr}(X, Y) = \rho_{X,Y} \ .$$

3. RESULTS & DISCUSSION

As mentioned, after data collection that was reached by testing users via cutting standard paper and scoring their emotion and feeling in SD questionnaires, all data were analyzed and some tables and charts had been reached. Table 2 shows the average scores of each Kansei word (adjective) for each type of scissors. Figure 5 is the comparison linear chart of table 1 that shows the image of differences among scissors about each adjective. According to this chart it is found that scissors type F in most Kansei words is the top scissors, except some adjectives like Good grip, Resistant and Powerful that scissors type C is better than the others. Another result that can be found of this chart is in most of Kansei words arrangement of 1st scissors to 5th is the same with a few change. That is include type F-C-A-B-E, in some words C and in other F is the best.

Table 2: Average of each Kansei word score for each type of scissors

| Kansei words	A	B	C	D	E	F	G	H	I	J
Sharp	5.9	5.7	6.2	4.3	5.5	6.3	5.0	3.8	5.0	4.5
Pleasant sound	5.3	4.8	5.5	3.2	5.0	5.7	4.3	3.4	4.1	4.2
Beautiful	4.5	4.1	5.0	4.0	5.0	5.4	4.9	2.8	3.6	4.3
Good grip	4.3	4.2	5.3	2.2	4.3	4.2	3.9	3.2	2.1	2.6
Dangerous	3.8	3.5	3.9	3.5	2.9	4.0	3.7	3.0	3.5	2.1
Small	1.4	1.8	1.5	1.6	3.8	3.6	4.5	3.7	6.2	5.6
Tormenting	3.1	3.6	2.3	5.7	2.7	3.2	3.7	4.5	5.1	4.3
Blunt	2.1	2.7	1.9	4.1	2.6	1.7	3.2	4.1	3.2	3.5
High class	4.1	3.4	4.4	3.2	4.6	5.3	4.5	2.6	3.2	2.3
Match	4.1	4.1	4.8	2.9	4.2	4.6	4.5	3.6	2.9	3.7
Special	3.5	2.7	3.3	3.0	4.0	5.2	4.2	2.2	4.2	5.1
Good material	4.3	4.3	5.5	3.9	5.0	5.7	4.7	2.8	4.1	3.6
Shiny	4.5	3.4	3.4	2.6	3.8	4.9	3.7	3.1	4.2	2.5
Two sided	1.7	1.5	1.9	1.6	6.2	4.3	3.7	5.7	5.8	2.1
Decorative	2.9	2.1	2.8	3.2	4.3	3.3	3.0	2.2	3.8	5.7
Funny	3.2	2.2	3.2	3.1	4.5	3.1	2.8	1.9	4.6	6.2
Usable	5.4	5.1	5.8	3.3	5.0	5.6	4.8	3.7	3.5	3.8
Portable	2.7	2.9	2.9	2.3	5.2	4.5	4.8	4.6	6.6	5.9
Accurate	4.4	4.4	4.6	2.7	4.9	5.3	4.7	3.3	4.7	3.8
Powerful	5.4	5.4	6.0	4.8	4.1	4.5	4.3	2.9	2.7	2.4
Delicate	2.2	2.3	2.6	1.9	4.5	5.2	4.8	3.5	5.5	3.6
Resistant	5.5	5.0	5.8	5.2	4.0	5.0	4.2	3.2	3.2	3.0
Thick	5.1	4.8	5.4	5.8	2.6	2.5	2.6	2.9	2.1	3.1
Tight	2.8	3.1	2.2	4.4	4.0	4.1	4.2	3.8	5.6	5.2
Admired for all	4.1	4.0	4.4	2.9	4.7	4.5	4.6	3.7	3.2	2.9
Digestible	2.7	3.6	3.3	2.4	5.3	4.7	5.6	5.1	5.8	5.3
Flowing	5.0	4.6	5.5	2.2	5.0	5.8	4.0	3.1	3.8	3.9
Graceful	4.2	4.5	5.2	3.2	4.2	5.5	4.9	3.5	2.6	1.9
Physically tiresome	3.3	3.6	2.8	5.8	3.3	3.2	4.0	4.7	6.0	4.4
Boring appearance	3.6	4.4	2.7	4.4	2.6	2.8	2.8	4.8	4.1	3.5
Proficiency	4.9	4.6	4.9	2.5	4.5	5.5	4.6	3.5	3.7	4.1
Colorful	4.7	4.3	5.0	3.5	4.8	5.5	4.5	3.2	4.3	4.7
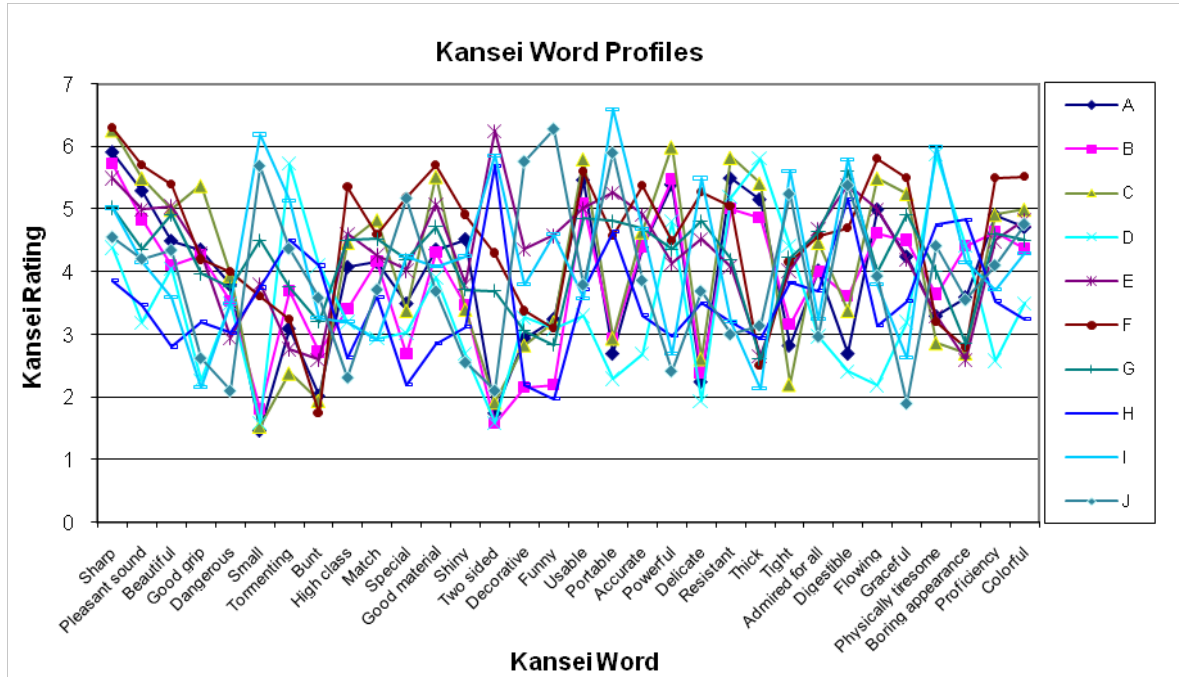
Figure 5: Comparison of Kansei words' scores in all scissors types

For comparing each scissors with itself, another chart in figure 6 shows these differences. In this chart it is shown that range of scores in each scissors is how. In an example that had brought here, Type F among other scissors had highest scores and most of the words' scores are more than 4.5 and it shows that users had special attention to this type (figure 6). The results indicated that type H among scissors that the range of scores was lower than others and most of them were about 3 that shows it was perhaps horrible for users.
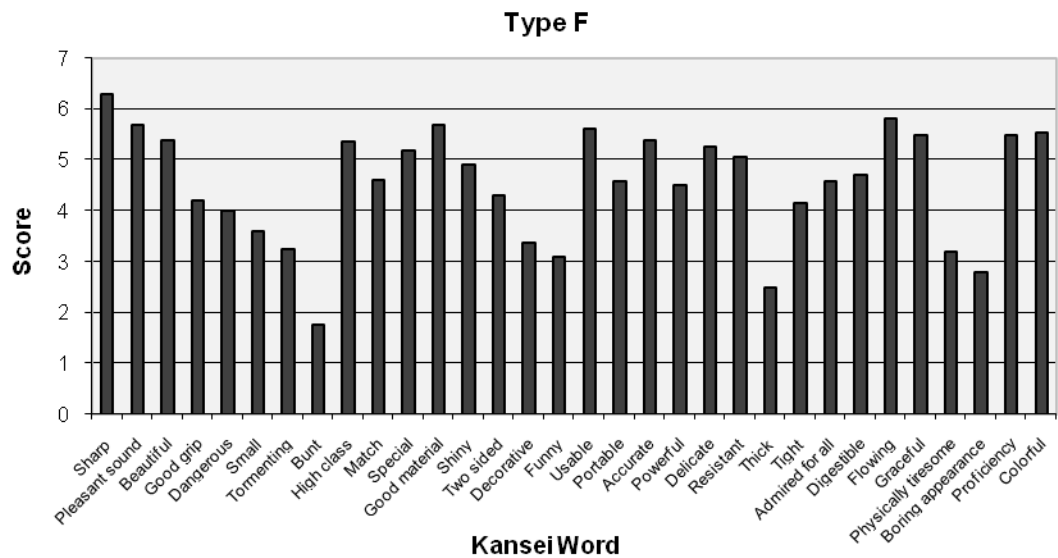

Figure 6: Comparison of Kansei words' scores in each scissors type (Scissors type F as the best scissors)

The linear chart average of all scissors scores' has been shown in figure 7. This figure shows the importance of each Kansei word for users participating in this survey. However

some of the Kansei words had positive meaning and some had negative and comparing these two with each other is not correct. But many of negative Kansei words are emphasizing of their opposites. For example word Sharp had the highest score among all words more than 5, and it can be seen that blunt as the opposite of sharp got the lowest score among all less than 3.
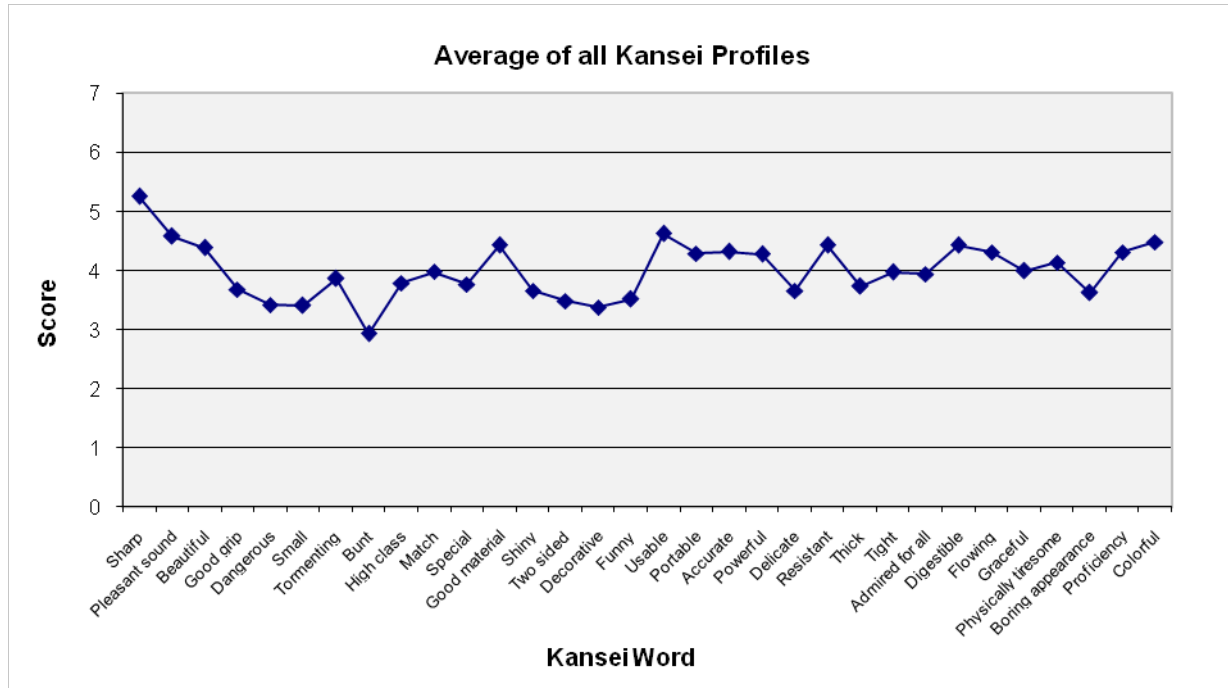

Figure 7: The linear chart average of all scissors scores

For data analyzing finding the relations among Kansei words and between these words and design elements were needed. So, correlation coefficients of each couple adjectives were estimated and a numerical correlation among these words had been reached. These correlations classified these words that via closeness in figure 8 had been shown.
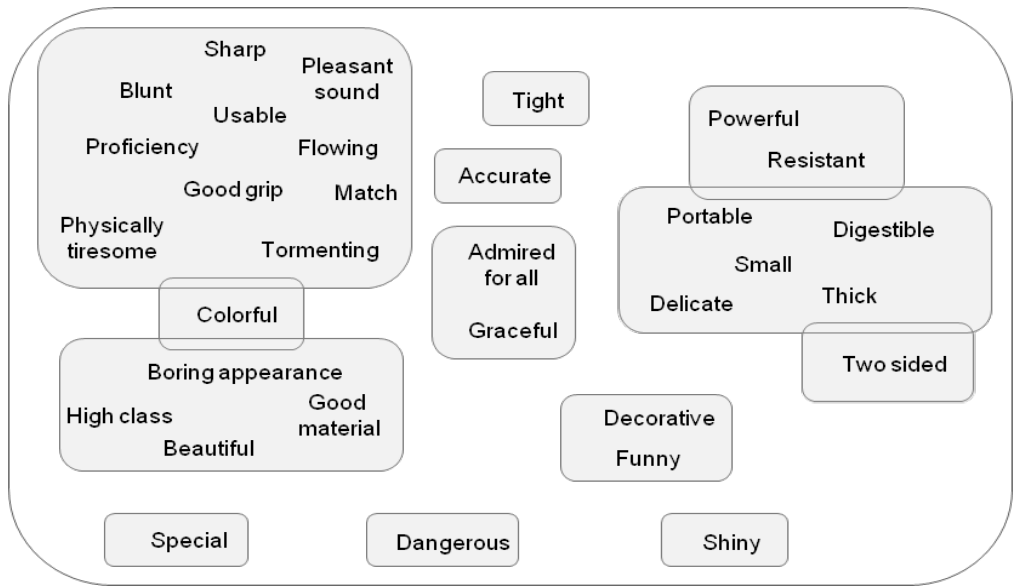

Figure 8: Classifying Kansei words according to numerical correlation among them via closeness

This figure shows that words that are close to each other except their numerical correlations have meaningful relation with each other. Good grip of scissors can effect on scissors sharpness and these two can make a scissors usable, so this would result scissors in not becoming physically tiresome, or high class scissors also seems beautiful for users. By this classification, according to cluster analysis, these words could classify in certain groups and clusters. Table 3 shows these clusters and the meaningful relation is clear in this table.

Table 3: Classifying Kansei words in identified clusters

Cluster 1	Sharp	Pleasant sound	Flowing	Usable	Proficiency	match	Good grip	Tormenting	Blunt	Physically tiresome
Cluster 2	Colorful									
Cluster 3	Beautiful	Good material	High class	Boring appearance						
Cluster 4	Tight									
Cluster 5	Accurate									
Cluster 6	Graceful	Admired for all								
Cluster 7	Portable	Delicate	Thick	Digestible	Small					
Cluster 8	Two sided									
Cluster 9	Decorative	Funny								
Cluster 10	Resistant	Powerful								
Cluster 11	Shiny									
Cluster 12	Dangerous									
Cluster 13	Special									

It should be noted that, some of the words were between two groups and had correlation with both of them, these words went in new groups. After this classification and clustering, in another table, top scissors of each cluster with all positive included words were identified. Table 4 shows these identified types of scissors of cluster 1. According to this table top scissors in each clusters were the same with a few replacements. So, finally top scissors of each cluster were identified.

Table 4: Identifying top scissors of each cluster (cluster 1 here as an example)

	Sharp	F/C/A/B/E	
	Pleasant sound	F/C/A/E/B	
	Flowing	F/C/A/E/B	
	Usable	C/F/A/B/E	
Cluster 1	Proficiency	F/C=A/B/G/E	**F-C-A-B-E-G**
	Match	C/F/G/E/B=A	
	Good grip	C/A/B/F/E	
	Physically tiresome	-	
	Tormenting	-	
	Blunt	-	

Finally, these results matched to product details and categories that had been identified before. Each cluster separately was matched to figure 4. According to these findings, some design elements could be specified and considering to these elements sketching was started. Design elements were classified in four sections as follows:

Handle and blade
  Same direction
  Material priority:
   Unique
   3 different material
   2 different material
  Separated
  Handle-blade connector from
  Thickness difference

 Hinge
  Screw
  Cover priority:
   Without cover
   With cover
  Under hinge projected

 Handle form
  Large
  Small with outgrowth
  More delicate
  Cursive
  Non symmetry
  Dimension: (type C)
  Non symmetry
   Pollex min=1cm, max=2.6cm
   Other fingers min=1.3, max=2.1 cm

 Other
  Handle and blade length proportion 1.2cm
  Blade form like type F

Figure 9: Final concept

For sketching about these results, top views of selected scissors after analysis were captured and these scissors were mixed and some new sketches were made. Considering to more relation with specified design elements and innovation final concept (figure 9.) had been selected and modeled with 3D modeling software. Figure 10 shows final concept and its relation to research's findings and design elements.
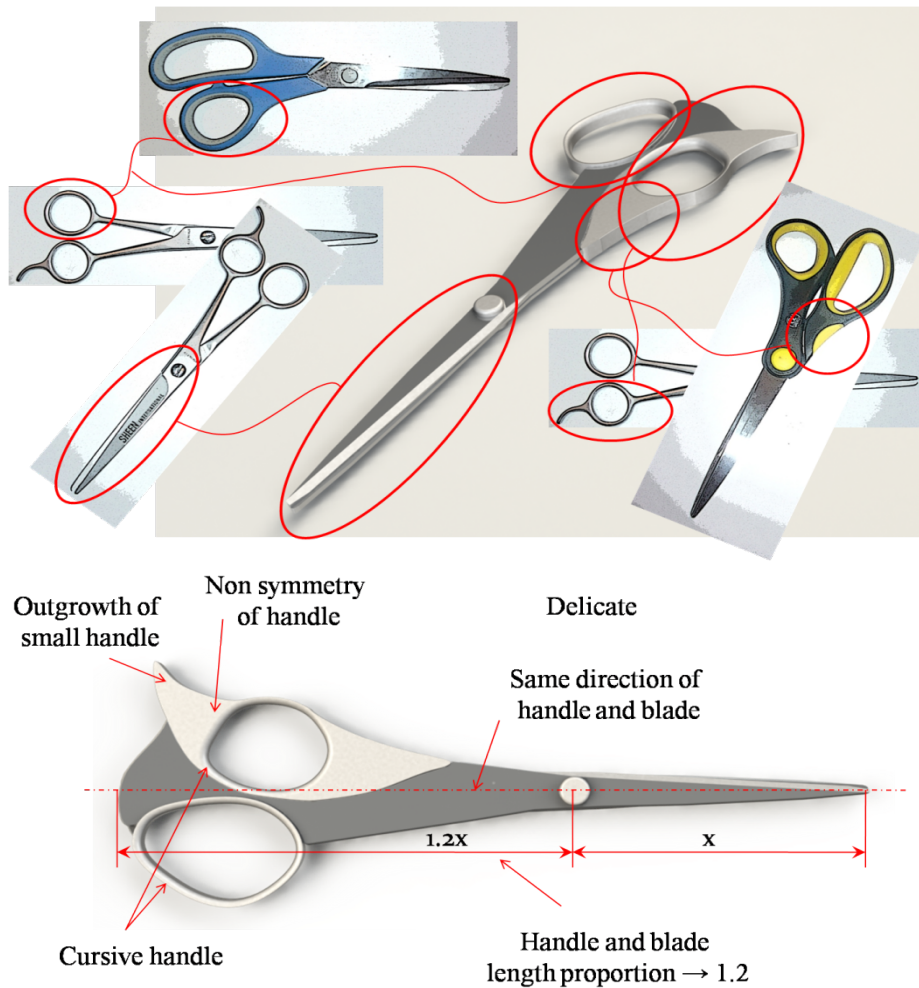
Outgrowth of small handle

Non symmetry of handle

Delicate

Same direction of handle and blade

Cursive handle

1.2X

x

Handle and blade length proportion → 1.2

Figure 10: Final concept and its relation with research's findings

4. CONCLUSSION

This study had been done to use Kansei engineering with the aspect of second level of emotional design (behavioral). Other projects [4, 5, 7] that were reviewed before starting this study were about observational feelings that users had about a product. Here other feelings were added to those, so that would be different from the works that had been done before. In other projects they should use some pictures of products and at last product details and categories are clear, as an example, when the project is a kettle, it is clear that its shape and those adjectives that relates to observation become important and finally product details are something like circular, rectangular or triangular body or handle connects from the top of product or from the beside. But here it was so different. As an example "pleasant sound" was one of the adjectives, so which details of product would connect to this word, and at last which design element could show the effect of this word in final design. Another noticeable thing here was that, in this survey the material which was cutting was paper and a delicate work was done. Perhaps the reasons of selecting scissors type "F" (a delicate scissors) as the top scissors were the cutting material and type of work (following a complicated path). Also the ratio of selected proportion between handle and blades by users according to research's findings was 1.2. This would selected because of the complicated path and cutting material that users must cut, if we had fabric as cutting material the result would be different. They

must control no rigid material. So they could not keep it by their hands and they could not move that from the surface that it was place on. However, most of the times fabrics are cut in straight and large curve lines. As another example, cardboards are thicker than papers, so cutting would need more power and delicate scissors are not suitable for this material. This study can be continued via other design methodologies that have relation with users and can be completed with other aspects. This research continued with making final design's prototype and can be completed with another Kansei research that will be result in if this design satisfies its users or not.

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