



A STUDY ON THE DESIGN THINKING PROCESS WITH DIFFICULT KEYWORD

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1. Introduction

From the view of design thinking process in general meaning, the creative design process can be represented as a translation process from verbal description of goal to make the visual image of end object. We aimed to make a new viewpoint for the theory of design fundamentals under this thought. In this research, we tried to make a model of creative thinking process in design. The model was constructed on the basis of results of experimental studies. Those experiments were held in 2000 and 2001 to know about creativity in design thinking process. We focused on designers' drawings, which were important clues to examine creativity in design process. Goldschmidt [Goldschmidt 1994] considered that sketches of architects were representations of their 'visual thinking', which gave important clues for research of their thinking processes. Purcell and Gero [Purcell 1998] described about it as 'visuo-spatial' expression. Nagai and Noguchi [Nagai 2001] found several thinking types from analysis on designer's drawings in their experimental studies. Based on those experiments, we thought that the keywords in the goal description gave a direction of thinking in the searching space [Noguchi 1998, 1999]. The designer's thinking process seemed to be composed of interactions and interpretations between verbal expressed concepts and image configurations that were destined to final forms.

The feature of this study was based on the experiment which was planned to make easy grasping the thinking process by using difficult keywords to image directly to forms. Here, we meant the "keywords" as the most significant predicative words in goal description. For example, if goal description is "design lovely small kettle", keywords are "lovely small".

Before this experiment, we had another design experiment, in which the subjects were assigned to design two flower vases with keywords "soft imaged" and "humorous". From the result, we found that even if the same person, the subjects seemed to change their thinking modes depended on difference of the keywords (Figure 1). We named the thinking mode F that was seen when the subject thought with the keyword "soft imaged", and mode M when the subject thought with the keyword "humorous". When the subjects thought with keyword "soft imaged", they seemed to draw sketches easier than with the keyword "humorous" because they could easily connect the keyword to the forms of flower vase. However, the results were brought not so many fresh designs. When they thought with "humorous", drawings seemed to get from metaphors which made associate the humorous thing or humorous expressions, because with the keyword "humorous" they could not think directly the form of flower vase. Then, in case of nicely thinking, they could make fresh design of flower bases with the key word "humorous" (Figure. 2). After that experiment, we considered that if the subject assigned a design task with more difficult keyword, we might get more detailed data of design thinking process from the subject's drawings.

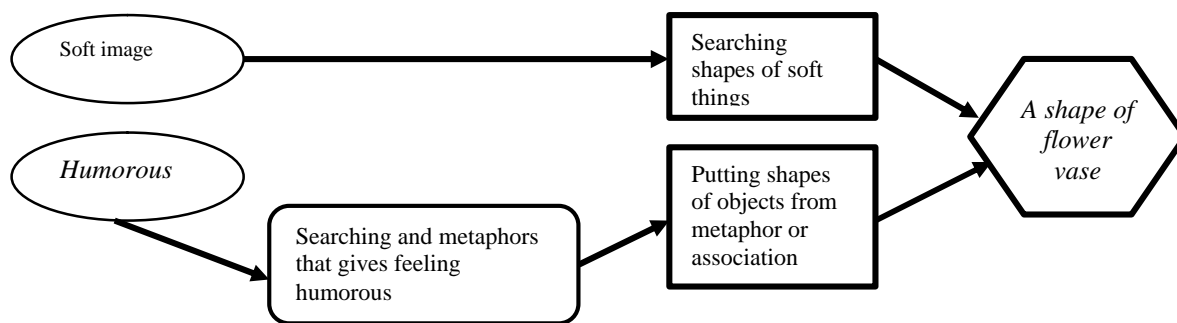


Figure 1. Thinking process of flower vase design

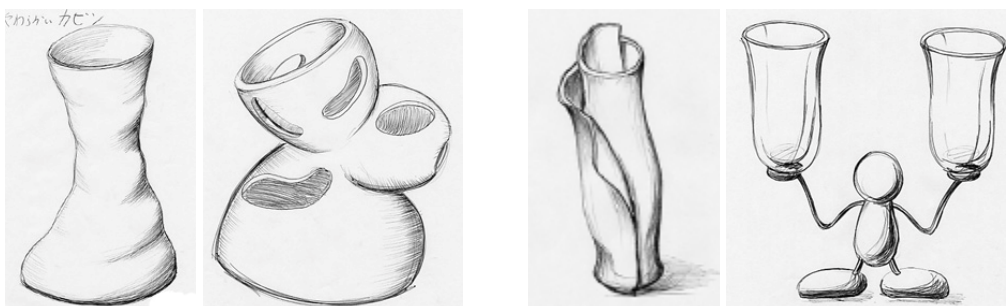


Figure 2. Drawings of flower vases, 'soft image' and 'humorous image' on each subject

2. Experiments

In this paper, we presented an experiment after the experiment above mentioned. We put attention to understand how interaction might be occurred between verbal concepts and visual images under the creative thinking in design process.

2.1 Purpose of the experiment

The purpose of this experiment was to know how designers made visual images of design object from given goal description. We made this experiment starting from goal description including difficult keywords to translate to visual form. Our intention was that the difficult keywords would make longer thinking way in design process and it would give suitable condition of observing the thinking process. Additionally, to get clue of thinking process, we gathered all words written on the sketches and drawings by the subjects during the task. Then, we evaluated the subjects' drawings and examined all words written on the sketches during the task.

2.2 Procedure of the experiment

This experiment held as an exercise of basic design training at Chiba University in October 2000. The subjects were About 80 students of 1st year class of Department of Design in Chiba University. The subjects were assigned a task of design 'a chair which makes sad image'. All the subjects were made to draw their idea within 60 minutes. The subjects were instructed to describe comments in their sketches if they needed while drawing. Afterward, they drew coloured sketches as a final presentation. After finished the final sketches, they were made to describe their impressions about the task.

2.3 Method of evaluation

After gathered all sketches, two expert design educators evaluated 76 sets of sketches by 3-steps grading on every evaluation items as shown below.

1. Whether final form was realized keywords or not?
2. Whether basic function and structure of chair were realized or not?
3. Whether the design was fresh or not?

4. Whether the form was developed in the process or not?
5. Whether it was divergent thinking or not?
6. Whether the words were structured or not?

2.4 Results of the experiment

2.4.1 Results of evaluation

After the evaluation, we totaled the following facts as the results of this experiment. The results were shown in table1 and table2.

1. The largest number, (46) of subjects was seen in the item 'basic function and structure of chair were realized' and the smallest number, (7) was seen in the item 'it was divergent thinking'.
2. There was apparent correlation between 'the form realized keyword' and 'the design was fresh' on correlation values between each item.
3. There was weak correlation between the item 'basic function and structure of chair were realized' and the item 'it was divergent thinking'.
4. There was weak correlation between the items 'final form was realized keywords' and 'the words were structured'.

From those results, we found that this task was very difficult to connect the basic function of chair and the given keywords.

Table 1. Rate of success

	Final form was realized keyword	basic function and structure of chair were realized	the design was fresh	the form was developed in process	divergent thinking	words were structured
Rate of success	23	46	24	18	7	17

Table 2. Correlations of each evaluation items

	Final form was realized keyword	basic function and structure of chair were realized	the design was fresh	the form was developed in process	divergent thinking	words were structured
Final form was realized keyword	1.00					
basic function and structure of chair were realized	0.09	1.00				
the design was fresh	0.49	-0.27	1.00			
the form was developed in process	0.14	0.01	0.12	1.00		
divergent thinking	0.14	0.31	0.03	-0.22	1.00	
words were structured	0.27	0.043	-0.06	0.03	-0.02	1.00

2.4.2 Analysis of the searching process

We picked up all the words written in sketches and written as a comment, to get clues of understanding the thinking process of subjects. Then we examined them and structured the words into hierarchy of concepts (Figure 3). From this meaning hierarchy, we can guess how the subject draw sketches by using keywords in the hierarchy of sad image concepts. We discussed how the subjects could reach to the forms by going down the hierarchy of concepts. A framework of expression of the form was changed by difference of the keywords in first class hierarchy, however there was a parting point of the ways of thinking out a form of chair in the middle hierarchy of meaning of sadness. In case of using metaphor of 'pose of sadness', subjects seemed to think the form of chair in imaginations of when they were sad (Figure 4). Then they could make creative forms of chair. In contrast, with the

keywords 'instability' and 'restricted' they seemed to think the forms of chair based on their existing concepts of physical situation in meaning of the keywords (Figure 5). Therefore the form was tended to be symbolic and often stereotyped. In addition, the words 'dark' 'blue' 'heavy' and 'cold' were not in the hierarchy and they were directly associated physical attributes of sadness.

1st class hierarchy in meaning of sadness	2nd class hierarchy in meaning of sadness	3rd class hierarchy in meaning of sadness	words directly related to form
solitude	lonliness	alone	back to back face to wall
	sorrow		
	blocade	restricted pressured compulsion	stiff narrow twisted distorted hang over
anxiety		instability	weak swing thin tall long left up in th air one legged three legged lacked lost the back make a hole
		protected	enveloped
disappointment	getting depressed	pose of sadness	bow bent forward hung down
	powerlessness		low sink ragged thorned
uncomforable	agony pain		
directly associated physical atributes from the word sadness			dark blue heavy cold



Figure 3. Meaning hierarchy of word 'sadness' and samples of the subjects' drawings

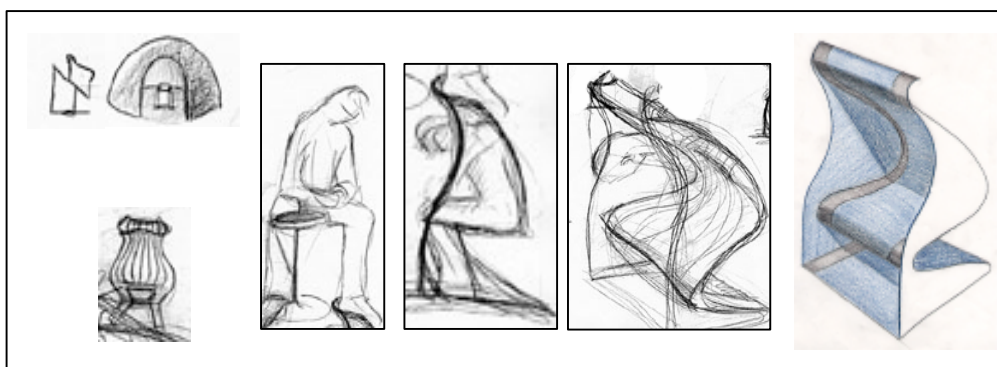


Figure 4. Drawings from poses of sad feelings



Figure 5. Drawings from concepts of instability

3. Discussions

We considered that it was not difficult to realize forms of a chair as an object which has, at least, function as a chair. Also, it was easy to remind some metaphors associated to sad image. However, it was quite difficult to connect ‘form of a chair’ and ‘sad image’. We confirmed it based on the result of the evaluation in which ‘divergent thinking’ was low percentage of success. In spite of the difficulties, if it could successfully connect to the form of chair, it would be a fresh design. On the correlations between item ‘basic function and structure of chair were realized’ and the item ‘it was divergent thinking’, we inferred that the divergent thinking was tend to be remind in stereotypes of chairs. If the subjects searched the forms with stereotyped image, the forms would not be fresh design. On the correlations between ‘final form was realized keywords’ and ‘the words were structured’, we inferred that the subjects would try repeatedly to associate the word ‘sad’ with the form of chair in meanings of hierarchy until reach a suitable word.

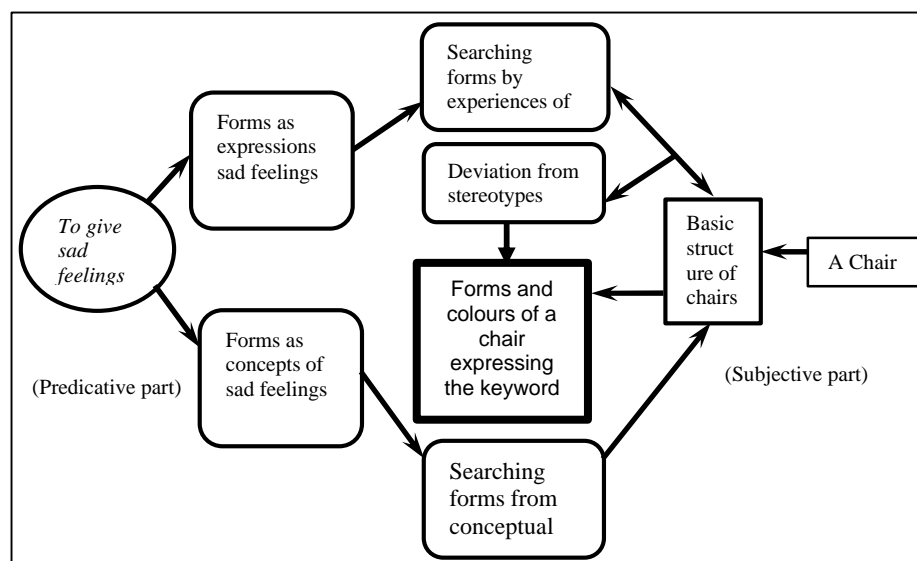


Figure 6. Thinking paths in design of ‘chair gives sad image’

We verified the thinking process of drawing by the concept hierarchy, and found that there were two different thinking paths in design thinking process from verbal expression of design goal to create visual form for it. Based on the analysis, we presented a model of thinking process in creative design as a translating process from keywords to suitable visual forms of it. (Figure 6). One of them was thinking forms by using metaphors of one’s pose in sad feeling. This needed to sink into one’s mind and had to take complicated path to make form of chair. The other was thinking forms by using conceptual metaphors and did not need complicated path. As the result, the former case had more possibilities of success in creating new form of a chair. We discussed the reason of it that the former

case needed longer thinking path in searching suitable forms, and had to make repeated drawings under considering good forms.

4. Conclusion

From the results and discussions of this experiment, we concluded as follows. When the verbal description of design goal was difficult to translate to visual image of design object, at first, designer tried decomposing the meaning of design goal to adequate level of meaning to be able to relate visual images. In most case, the suitable keywords were related to metaphors of representing the design goal. However, from the viewpoint of creativity, it was important that the visual image of metaphor should be adequately far from usual meaning of design goal. To reach the creative design, designer should make effort in long way thinking.

Then, we asserted that for understanding the creative thinking process of design, a represented model of thinking path would be available, and we tried to make it based on this experiment.

In next step, we prepared another experiment to know each designer's thinking process by minutely observations.

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