

21 Architecture Design as Two Searches

Knowledge of Spatial Organization and Knowledge of Shape in Design Process

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INTRODUCTION

In the theory of design research, design thinking has gradually become an important direction for the research. In early research of design thinking, due to the insufficiency of academic research in human thinking, we have been unable to make further research in the field of design thinking. However, with the remarkable development of a variety of subjects: such as management science, cognitive psychology as well as artificial intelligence and others, researchers engaged in design thinking have more clear methodologies and solid background to conduct research studies of design thinking process.

Ever since then, there have been many theories and models in design thinking. First of all, Herbert A. Simon (1981) developed a classic search-model which is a very important development in the theory of design thinking and design information-processing. He believed that design problem-solving was basically the same as the ordinary problem-solving which includes a initial state, a goal state and a number of intermediate states within the so-called problem space. Nevertheless, the ill-definedness of design problems makes design different from ordinary problems. His method infers that design problems neither have a definite goal nor a optimal solution. This theoretical model has significantly influenced the research directions of design thinking.

Following this theory, most researchers, based on Simon's search model, proceeded with an even deeper analysis into the study of design thinking. Some of them, with their knowledge in basic psychological theory, researched in designers' psychological phenomenon. Ömer Akin (1984, 1986, 1993) and his research group at Carnegie-Mellon University represent researchers who have researched the variety of psychological phenomena in computational theory proceeding their researching design. These type of researchers mainly perform the research in the three main subjects classified from the designers' mental activities known as representations, search, and reasoning.

While other researchers study the use of computers in the exploration of design thinking. Based on the recognition and application of cognitive science, research in this area has been developed by two main methods: the "knowledge -based system" and the " shape grammar".

In the approach of "knowledge-based system", specific knowledge encoded in computer programs is used and is expressed by "rules." (Anderson, 1991) This kind of computer

program can produce on paper a variety of designers' requests for a design function. (Gero and Maher, 1988; Liu, 1991)

In addition, the approach of "shape grammar," uses definite grammar rules and vocabularies to derive indefinite sentences. Shape grammar uses design knowledge to produce some pattern rules. A great number of different rules are used to derive a variety of different design through a number of transformation steps. (Stiny, 1980)

In this paper, we continue our previous research on the discussion of design mental activities, and we would like to continue exploration on the "knowledge of spatial organization" and "knowledge of shape." In the field of design connected to iconic and spatial thinking (for example: architecture, industrial design, interior design...); "knowledge of spatial organization" and "knowledge of shape" have always been the two important studies for design thinking research. Knowledge of spatial organization, which is more similar to what we said of the knowledge of function, mainly indicates the relationship between spaces, the application and the purpose of space; and what we said of the "knowledge of shape" mainly indicates the devices and arrangement of spatial shapes.

In this paper, our research is mainly to explore the difference between the "knowledge of spatial organization" and the "knowledge of shape" in terms of issues underlying the processes of knowledge structure and knowledge formation. For the present, since our research is still in the early stage, we have only a vague and quite rough idea of the variety of problems. In previous research in the development of design thinking, protocol analysis is very popular and important in studying thinking issues of design. Ömer Akin (1993, 1995), Donald Schön (1992) and others conducted their research by means of protocol analysis. We therefore approach this study by means of protocol analysis developed in cognitive psychology.

EXPERIMENTAL PROCESS

In this experiment of protocol analysis, the subject that we chose to use for the experiment was a designer who had been educated in college for architecture and have acquired five-year professional experience. For the first stage of the experiment, the experimenter gave the subject a design task concerning architecture. The subject was required to proceed the design solution. At the beginning of the experiment, the experimenter first explained the task and the requirements for the experiment. Before the subject started his design work, he was allowed to ask questions and practice in order to warm up until that he comprehended the task and the requirements of the experiment. We asked the designer to tell us what he was doing, the way he thought, and the reason for doing so during the whole process of his design work, and we kept records with a camera for the whole process.

For the next step, the second stage of the experiment proceeded 30 days after the first stage, the subject was asked to recall his design work as completed as his could, and gave a description in details on paper. Since, in the first stage, the subject was not told that he would have to do the recall, this experiment was unexpected by the subject.

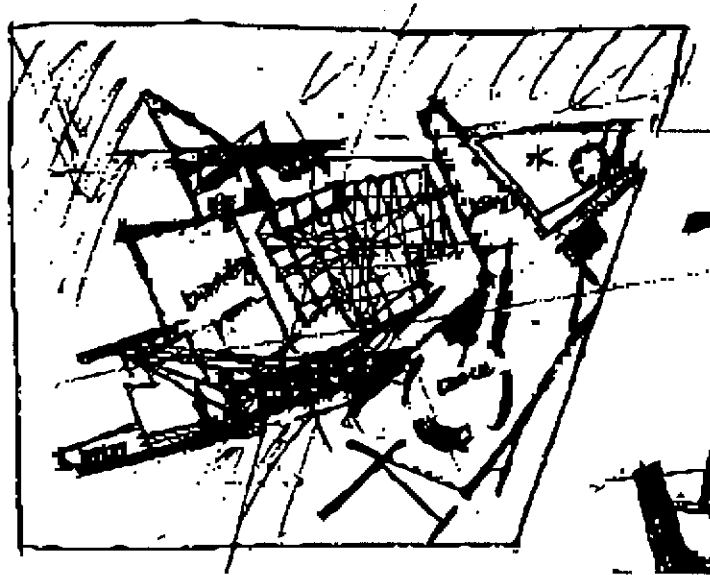


Figure 1 the first stage

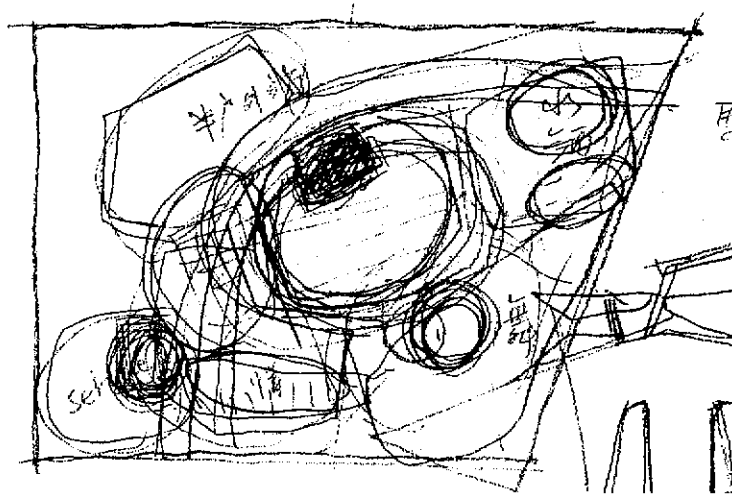


Figure 2 the second stage

CONCLUSION

The experiment results indicate that, in the second stage, the subject failed to be able to recall completely his design work of the first stage. The layout he drew in recall was quite significantly different from the one he drew 30 days before in the first experimental stage. What the subject could recall at most was the knowledge of spatial organization. For example, the subject could recall the position of the central area (core), the spatial relationship between the restaurant and the dance hall, the spatial organization of the restaurant. We find that, 30 days after the end of the first stage, what can be retained in the subject's long-term memory is mostly knowledge about spatial organization.

According to the above finding, some phenomena can be observed: the knowledge of spatial organization is easier to get organized and stored in long-term memory in design thinking process. To validate the results, of course, further research is needed:

- Knowledge applied to design thinking is mainly the kind of knowledge of spatial organization; and, in comparison, the knowledge of shape is rarely used.
- Knowledge of spatial organization plays a critical role in the processes of knowledge formation and knowledge application.
- The nature of shape is greatly changeable and flexible; it can be used as comparatively "rule-less" element to create a great variety of designs.
- The rules of shape grammar depending on shapes need further research to reflect the designer's shapes recognition and reasoning.
- Finally, we must take into consideration that, in some conditions, shapes will be easier to be organized in long-term memory.

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