NOTION OF DUALITY IN VISUAL SYSTEM AND ITS IMPLICATION FOR ENVIRONMENTAL DESIGN

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INTRODUCTION

Judging from the growing number of papers presented at the annual conference of the Architectural Institute of Japan, architects and architectural researchers' interest in environmental psychology is steadily increasing (Inui,1982). However, many of these papers, particularly dealing with environmental perception, lack solid theoretical background. It may be partly because researchers can utilize an available "package" of existing psychological research tools with computer programs for analyses. For instance, multidimensional, or multifunctional analysis, which is now a very popular technique, is applied to "digest" numerous characteristics of an physical environment in order to explain human responses to it. In doing this, a number of elements in the environment are often arbitrarily chosen without a good theoretical framework. Thus, no clear conclusions can be obtained.

It may be useful to propose a model of environmental perception which can suggest what aspect of the environment is relevant to a certain kind of behavior. In other words, if we know what kinds of stimulus information in the environment are processed and utilized by human observer in a certain situation and in a certain behavior, then architects can design an environment quite effectively for a certain purpose. For instance, when considering the visibility and legibility of emergency exits in large underground shopping malls in the city center of Tokyo, research based on such a model may suggest how to locate signs and design other surrounding features.

This paper, reviews recent findings in physiology and psychology which suggest there are two different mechanisms in processing visual information, namely focal vision and ambient vision, and discusses the implication of this notion for environmental design and research.

CONTEXT

My interest in visual perception in the environment is initiated by a rather naive question: what makes us feel different atmospheres or moods in different places? For example, when we visit a farmers' village far from Tokyo to see MINKA, or traditional folk houses, we find ourselves surrounded by a quite different "visual" atmosphere from that of the city center in Tokyo.

DUALITY IN VISUAL SYSTEM

One may point out the differences in such elemental features as forms and sizes of buildings scattered in the visual field: modern office buildings usually have large geometrical forms with sharp edges, whereas traditional folk houses have small irregular forms with curved and indistinct edges. For perceiving the visual atmosphere which surrounds us, however, environmental features such as density and arrangement of the visual elements or textures of architecture and landscape, seem to play more significant roles because a visual atmosphere can be felt instantaneously without the special attentive effort which is required to detect differences between elemental features one after another.

From this consideration, the general question of which aspects of the physical features of environments affect our experience was made the focus of our study. What aspects of texture affect our experience? How can we describe textural experience? To answer these questions, a series of psychological and psychophysical experiments were conducted to investigate the relevance of surface roughness of building materials to the overall evaluation of texture, to create a scale for the measurement of apparent surface roughness, and to clarify the influence of observation conditions on apparent surface roughness (e.g., Ohno, 1980). With these exploratory experiments, we have obtained the answers to several subproblems, but we have not yet reached a general conclusion.

While studying visual perception of texture, we found that little is known about the perception of environmental features. Perceptual psychologists have been concerned primarily with the perception of objects or figures, and textures were carefully omitted from the stimuli in their experiments. As Ittelson (1973) has pointed out, those theories extracted from object-oriented research may not fully explain perception of environment. Gibson's works, however, were a rare exception dealing with perception of surfaces with textures(Gibson,1950a). He provided us with a more promising theory for understanding the perception of environmental features (Gibson, 1950b and Gibson,1978).

Gibson's discussion led our interest beyond perception of texture into a theory of visual perception in general. There is a clear contrast between traditional object-oriented approach and Gibson's approach. The essential difference between the two approaches seems to be derived from different conceptions of the basic units which convey stimulus information in the visual field, in other words, the differences in ways to abstract the visual field. Landwehr's paper (1984) "on the minimal stimulus information for something to be seen" clearly demonstrated this difference (see Figure 1). The homogeneous "Gantzfelt" (Metzger, 1930) where nothing is seen is supposed to be filled up in two different ways. Traditional theory begins with a minimal point and then extends to lines, figures, and abstract solids. Gibson's theory on the other hand

begins with a textured horizontal plane as a minimal stimulus information, which may be associated with the plane of the earth's surface, and extends various layouts of texture, or "ambient optical arrays" (in Gibson's term).

Although these two approaches are quite different, both of them may be valuable when they are applied to suitable situations. The theories extracted from object-oriented research may explain more about perception when people fixate their eyes on each individual element and obtain detailed information, whereas Gibson's theory may explain more about perception when people get visual information from a wider field. This dualism in the theories of perception may be more acceptable if we hypothesize two different mechanisms of visual perception, which will be discussed below.

NOTION OF DUALITY IN VISUAL SYSTEM

Our attention to the notion of a duality in vision, or the existence of two parallel visual system, has stemmed from psychophysical experiments in which we found that the visual perception of texture and aggregated objects differed in the degree of "perceptual constancy" (Chatani, Ohno and Kobayashi, 1980). Experiments were conducted to investigate the quantitative relation between physical surface roughness and perceived visual roughness under different conditions of observation. The stimuli were granular surfaced panels, 45 cm x 45 cm in size, on which spherical particles of an identical size were glued (Figure 2). When using a stimulus composed of small grains, which was seen as texture, observer's judgements of visual roughness were quite "true" to the retinal image,i.e., when a stimulus was moved to change observation distance, the judgement of visual roughness equally changed. On the other hand, when using a stimulus composed of large grains and seen as aggregated objects, the observer's judgements did not change as much as expected with the change of grain size in the retinal image, i.e., it presented a size constancy like phenomenon. A similar result was obtained when lighting conditions, namely the angle of incident light and its intensity on the panel were changed (Chatani,Ohno and Kobayashi, 1985).

These results suggested two different aspects of visual perception: perception of texture, which "honestly" responds to the change of stimulus, directly informs us of changes in the visual field, and therefore informs the relationship between the body and spatial configuration of surfaces. Whereas, the perception of objects, which stays more constant under changes of stimulus, creates more stable vision.

Not a few physiologists and psychologists seem to have proposed