

### XIII. PROCESS ANALYSIS AND SYNTHESIS

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#### RESEARCH OBJECTIVES

There are many interesting problems that have a definite communication character but that are extremely difficult to handle with any existing analysis or synthesis procedures. After rather intuitive beginnings, some preliminary experimental evidence has been assembled to lend plausibility to the idea that the study of such problems from a new viewpoint may lead to an enrichment of our present theories of communication. During the coming year, experiments that we hope will prove to be more definitive will be performed to substantiate the validity of the approach and to support further development of the theoretical concepts. A few illustrative examples will help to convey the character of the problems being discussed here.

Let us consider, first, the question of pattern recognition. Substantial advances have been attained in the formulation of theories for designing machines that can distinguish patterns previously selected by the designer of the machine. The patterns that existing machines can handle have simple geometrical configurations. Now, let us make the following observation. Because of the functional activity of the human brain we are capable of recognizing with ease a tremendous number of figures that have complicated geometrical and tonal structures and other subtle variations. We can recognize, for example, a very large number of human faces having negligible or strong differences. We can recognize with ease complicated styles in paintings. We can recognize voices, odors, and so forth, and we do all of this with remarkable skill. The brain obviously has a tremendous capacity for recognition and uses processes or methods that produce rapid and effective solutions. The activity of the brain points out that:

- a. The problem of pattern recognition has solutions, even when there are negligible differences between the patterns.
- b. There must exist very effective methods of solution, as evidenced by the remarkable speed with which the solutions are produced by the brain.

Let us now consider the question of signal separation. Suppose that we want to separate a signal that is immersed in tremendous noise, or that we want to separate it from other strong signals that are highly correlated with the desired signal. Present theories are inadequate to produce solutions to this problem. However, examples can be given showing the remarkable ability of the brain to separate negligible signals that are highly correlated with a background of numerous strong signals. Again, the activity of the brain clearly indicates that simple and effective methods of signal separation must exist.

Now we shall consider the question of picture representation. Picture representation is an important branch of the theory of communication, yet here again we find ourselves in a difficult situation. To produce a good two-dimensional pictorial representation of one or more subjects, particularly of people – for example, by means of paintings, drawings, photographs, and the like – presents a complex problem if the main objective of such representations is to preserve certain physical and psychophysical characteristics of the subject which strongly impress themselves upon our intellect from direct observation. Experience tells us that a mere physical representation – such as a straight unretouched photograph – fails consistently to preserve and reveal important subjective qualities. A good artist, on the other hand, possesses the natural gift of expressing with directness and simplicity the qualities of the subject which so manifestly affect us. Artists can even enhance and reinforce in their pictorial representations the conspicuous psychic characteristics of the subject. By the effect of the brain and through the hand of the artist, a picture comes alive and conveys to us a message, establishing thereby a subtle but powerful communication between artist and observer. Because of the profound transcendental meaning of such forceful, compact, simple, and beautiful representations we are, technically speaking, deeply interested in psychophysical representations. The question of extending the general theory of communication to embody these beautiful and excellent means of the transmission of

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intelligence is indeed provocative.

Considering the present state of our communication theories, the desires expressed above may sound like wishful thinking. Of course, our present understanding of such problems is sparse. However, the problems in themselves are of basic importance, and deserve to have work done on them.

We do not intend to suggest that our direct objectives are to discover the specific processes or methods that are used by the brain in solving its functional problems. Such expectations go beyond our times. Basically, we consider the brain only as a sort of intuitive "existence theorem." Except for the brain, we have no other criterion for establishing these solutions at the present time. This fact furnishes a sort of philosophical basis for the work of this group. That is, if the brain indicates that a fundamental process has a solution, then work has to be done in an appropriate direction, with the use of a large dose of intuitive method.

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