

## XIX. PROCESS ANALYSIS AND SYNTHESIS

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### RESEARCH OBJECTIVES

During the past years, this group has been investigating several basic problems and questions that may play a fundamental role in the further development of Communication Theory. These problems and questions may yield new directives for research in some basic but still obscure areas of this theory. The present linear and nonlinear theories of communication are not well suited to the handling of these basic problems, and there is little understanding of the way in which to construct processes to achieve their solutions. Some of these problems can be simply stated. However, we do not understand the nature of the functional process and mechanisms connecting the intervening entities and the final solutions.

Consider some illustrations. Take a weak signal immersed in a background of very intense signals, and assume that the weak signal and the intense signals are strongly correlated among themselves. The problem of separating the weak signal from such intense background is a task that is beyond the capabilities of our present theories. If we consider the whole system as being linear, such separation would be impossible and we might therefore conclude that such a problem has no solution. On the other hand, let us observe brain activity. There is abundant evidence that the brain is capable of isolating very weak signals under these same crucial conditions. With proper training of the observer, the isolation can be accomplished with ease and in a very short time. For example, a symphony conductor can detect immediately a slight error made by one violinist against a background of many violins and other instruments. Of course, we do not know the process that the brain uses to accomplish this isolation. But the fact that it does shows that such a problem of signal separation, somehow, has a solution. In handling other problems and trying to interpret many important questions we must look to the brain for a tremendous reservoir of "existence of solutions" of complex problems. In our research, we use the brain in this important capacity. Once we know that the problem "has a solution," we must try to develop the abstract procedure and methods to solve such problems. By this statement we do not intend to suggest that our direct objective is to discover the specific methods by means of which the brain produces the solutions. Such an expectation is far beyond our grasp, at the present time. We simply mean to develop methods and procedures for knowing in advance that a problem has a solution. In elementary problems of Pattern Recognition and Picture Representation we find a situation that is more difficult and obscure. It is well known that most of the decisions made by the brain in judging recognition are based primarily on subjective elements and characteristics, and that very few are based on objective elements and characteristics. In spite of the use of subjective directives, we all know that the brain is the supreme instrument of recognition. Now, in our present theories of communication, there is no room for subjectivity. However, since subjectivity plays such an important role, we must direct our research steps toward understanding the nature of the basic mechanisms and concepts. We must explore the possibility of isolating some subjective entities, to systematize them and to try to discover principles that govern the basic fundamental activities of these entities.

The research of this group on "subjectivity" has been limited to two definite fields, those of picture representation and music reproduction. In this work we have limited ourselves to simple basic questions of style characterization and transformation. Our reports have indicated the specific problems with which we are primarily concerned. We have also indicated the boundary of domains in which we operate. In the coming year the program of research will be concerned principally with the construction of some machines for music reproduction and transformation. Also, we shall consider an analogous situation in picture reproduction, since these machines are based on concepts and ideas that have been developed in this group. We are planning to have a new system

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of music reproduction in operation by the end of the year. The artistic criticism of the musical quality of reproduction will be given by Mr. George N. Humphrey, virtuoso of the viola and a distinguished member of the Boston Symphony Orchestra. Other experts in the field of music will be consulted from time to time.

Experimental apparatus for music reproduction, working along ideas and from designs formulated and developed in this group, has been in operation for the past two years in our laboratory. John S. MacDonald, Alan V. Oppenheim, and Thomas G. Kincaid, new members of this group, will be in charge of the design of the new machine that we hope to have in operation by next fall. Detailed information about this machine will be presented in subsequent reports.

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