XVII. COMMUNICATIONS BIOPHYSICS

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RESEARCH OBJECTIVES

The Communications Biophysics group studies chiefly the electrical activity of the nervous system; it is also concerned with certain aspects of auditory psychophysics. Our electrophysiological data are, as in the past, evoked responses to acoustic stimuli and so-called "spontaneous" activity of the brain-wave type.

Since our electrodes record the electrical activity of populations of neural structures, our mathematical models are appropriately statistical in character. We emphasize, however, close relations between mathematical models and experimental data.

During the past year we have considerably refined our "zero-interaction" model for the most peripheral neural responses in the auditory nervous system (1). Its applicability now extends to situations in which the clicks are masked by noise. We have also studied its relation to the variability features of large numbers of responses to identical stimuli. A probabilistic model for cortical responses to clicks has been developed (2): it is characterized by a certain number of additional assumptions that specify the way in which the behavior of a single neural unit is affected by what happens to its neighbors. This model, developed for responses to single clicks and pairs of clicks, has been rather successful in predicting the results of experiments in which three clicks in a row are presented to the ears of anesthetized animals.

We have developed instrumentation designed to assist us in the analysis of our data. The time-gated amplitude quantizer (3) and the neural latency monitor (4, 5) are appropriate for specific responses to discrete stimuli; the analog correlator for electroencephalography (6) processes continuous electrical activity. We have also constructed a special set of relay-operated timing and "gating" circuits to assist in the study of the way in which specific responses are affected by the spontaneous activity upon which they are superimposed. We are looking forward to the development of computing devices that will permit us to sharpen up and to test our mathematical models.

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References

1. L. S. Frishkopf and W. A. Rosenblith, Quarterly Progress Report, Research Laboratory of Electronics, M.I.T., Oct. 15, 1954, pp. 87-94.
2. J. Macy, Jr., Quarterly Progress Report, Research Laboratory of Electronics, M.I.T., July 15, 1954, pp. 75-80.
3. K. Putter, Technical Report 275, Research Laboratory of Electronics, M.I.T., Jan. 13, 1954.
4. A. K. Hooks, Quarterly Progress Report, Research Laboratory of Electronics, M.I.T., April 15, 1954, pp. 79-80.
5. A. K. Hooks, Quarterly Progress Report, Research Laboratory of Electronics, M.I.T., July 15, 1954, pp. 81-82.
6. J. S. Barlow et al., Quarterly Progress Report, Research Laboratory of Electronics, M.I.T., Oct. 15, 1954, p. 95.

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A. PHYSIOLOGICAL AND PSYCHOLOGICAL CONSTRAINTS UPON AUDITORY THEORY*

One of the tasks of auditory theory is the specification of physiological mechanisms whose operation upon acoustic stimuli yields the actual responses of the total organism. In practice, most theorists of hearing have been satisfied to account for data on pitch discrimination in terms of events that occur either in the sense organ, or in the auditory nerve or at the level of the auditory cortex. Many of the physiological models that have been suggested combine a tendency to deal with static sensory capacities with a disregard for response variables. An attempt will be made to review briefly some relevant findings on the electrical activity of the auditory nervous system; also to consider certain psychophysical data that have been collected by experimenters who have come under the influence of modern communication theory. The aim is not to endow the physiological models with greater face-validity but to refocus the attention of the model-makers upon alternative explicanda and possible building stones.

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