Semiannual Report, Contract Nonr 3579(04) (U)
1 December 1965 through 31 May 1966
Supported by Fund Transfer R-129 from
Office of Grants and Research Contracts,
National Aeronautics and Space Administration
and
Eighth Quarterly Status Report
NASA Number R-129-09-030-017 (U)
1 March 1966 through 31 May 1966

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by

Lloyd A. Jeffress

I. STATUS OF PROPOSED PROBLEM

A. Method of Free Response
(C. S. Watson and T. L. Nichols)

As an outgrowth of the vigilance studies completed earlier, a modification of Egan's method of free response has been developed. Results using the method will be reported at the June meeting of the Acoustical Society of America, and the work is being prepared for publication and for issuance as a DRL Acoustical Report. The abstract of the paper to be presented at the June meeting is included in the appendix.

B. Psychophysical Studies of Brightness: Effects of Adaptation on the Brightness of Positive and Negative Flashes of Light
(G. H. Jacobs and H. A. Gaylord)

The data collection phase of an experiment concerning the effects of adaptation on the brightness of flashed incremental and decremental stimuli is now completed. In that experiment (the data are currently being analyzed) estimates of brightness were obtained from 25 subjects who viewed brief (300 msec) flashes of light, varied stepwise over a range of 2 log units of luminance around an adaptation level. Each subject was run under four adaptation conditions covering a total range of 5 log units of luminance. The major interest here is in delineating the change in brightness for stimuli both above and below the adaptation luminance, and to see how this function depends on adaptation condition.

One particularly interesting finding, which has emerged from the preliminary analysis, is the indication that the brightness functions obtained show an inflection right at the adaptation luminance level; so the slopes for brightness changes in the incremental directions are systematically different than the slopes for brightness changes in the decremental directions. This difference appears at all the adaptation levels investigated. It is perhaps due to successive contrast effects.

C. Effects of Chromatic Adaptation on Color Naming
(G. H. Jacobs)

Chromatic adaptation effects have traditionally been investigated in the context of some variant of a matching procedure. Stimulated by the recent demonstration by Boynton and Gordon that direct color naming, properly utilized, provides as sensitive a tool as the matching procedures, we have collected rather extensive data from three subjects in an experiment which was designed to assess chromatic adaptation effects. Scaled color naming functions have been derived for conditions of neutral adaptation and for chromatic adaptation at 636, 452, and 538 nanometer. Preliminary analysis of these data have been completed and it seems clear that: (a) this technique yields highly reliable data, and (b) quantitatively meaningful measures of chromatic effects can be obtained from such an approach.

D. Signal Detection and the Width of Critical Bands
(R. B. Evans and L. A. Jeffress)

Work on this project has been started. The object of the experiment is to discover more about the shape of the critical band of the ear by a masking study in which the noise band can be varied from either side by the use of sharp cutoff, high-pass and low-pass filters. There is considerable physiological reason to believe that the band is not symmetrical, and that it is this lack of symmetry that is the reason for the rather wide range of estimates of the width of the critical band in the psychoacoustical literature.

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E. Psychometric Functions for an Ear Model: Effect of Duration
(L. A. Jeffress and A. D. Gaston, Jr.)

Data from this study will be reported at the June meeting of the Acoustical Society of America. An abstract of the paper is included in the appendix. In connection with work with the ear model, several important findings appeared, which will form the basis for an article to be issued also as a DRL Acoustical Report. The findings show that the ear appears to employ a kind of running average of the output of its rectifier (hair cells?), and that the distribution curves for noise and noise-plus-signal have shapes that are a function of the bandwidth of the filter employed and the length of the averaging time of the system. We have been able to fit human detection performance very closely by a proper choice of filter bandwidth and integrator time-constant. Several predictions about human performance have emerged from the study of the model and will be tested with human subjects.

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APPENDIX

ABSTRACT

Replication and Revisions of Egan's Method of Free Reponse. Charles S. Watson* and Thomas L. Nichols, Defense Research Laboratory, and Department of Psychology, The University of Texas, Austin, Texas 78712. - Listeners performance was measured under several conditions similar to that described by Egan as the "Method of Free Response" [J. Acoust. Soc. Am. 33, 993-1007 (1961)]. In addition to randomly spacing ten signals of low detectability, 150 msec in duration, 500 Hz, within each five-minute listening period, ten "noise-alone intervals" were also defined in each period. The latencies of first responses were measured, timed from the onset of each observation interval. Distributions of these response latencies were separately constructed for signal-plus-noise and for noise-alone intervals. Indices of detectability calculated from these distributions support Egan's conclusions that (a) signal strength must be increased by approximately 2 dB when observation intervals are not defined for the listener, if he is to maintain his performance at the level achieved with defined intervals, and (b) that this decrement in performance is largely a function of uncertainty about the exact instant of signal occurrence, and not of the sparcity of signals. [This work was sponsored by a grant from the National Aeronautics and Space Administration to the Defense Research Laboratory.]

*Present address: Central Institute for the Deaf, St. Louis, Mo.

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ABSTRACT

Effect of Signal Duration on Detection for an Electrical Model. Lloyd A. Jeffress and Audley D. Gaston, Jr., Department of Psychology, and Defense Research Laboratory, The University of Texas, Austin, Texas 78712. At the November 1965 meeting of the Society we presented the results of a series of unsuccessful attempts to replicate the findings of Green, Birdsall, and Tanner (J. Acoust. Soc. Am. 29, 523-531, 1957) on detection vs duration. Since then, still using a fixed-bandwidth filter, but by changing the time constants of the detector we have come much closer. Like them we have employed a continuous masker and a constant value of E/N_o and our new data yield a close fit to theirs. The filter is followed by a linear (half-wave) detector and by an integrator with a decay time of 100 msec. A replication of the experiment, this time employing a square-law rectifier (energy detector), and using the same integration time constants, yielded reasonably similar results. [Work supported through a contract with Bureau of Ships and a grant from the National Aeronautics and Space Administration.]

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