Two choice discrimination learning as a function of stimulus similarity along an auditory intensity dimension¹

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Abstract

One hundred-twenty Ss received 300 trials in a simple auditory discrimination learning situation. Each of two pure tones was associated with one of the alternative choice responses, and the combinations S_1 - A_1 and S_2 - A_2 were reinforced 100% with events E_1 and E_2 , respectively. The two tones differed only in their intensity, and ΔI was varied between 0 and 6 db. Proportion correct responses was a linear increasing function of ΔI , and there was no stimulus intensity dynamism effect on response probability.

Problem

The purpose of this experiment was to determine the function relating two-choice discrimination learning to variation of stimulus similarity along an auditory intensity dimension. It was expected that the proportion of correct responses $P(A_i/S_j)$ would increase as the intensity differential ΔI between the two stimuli increased. The exact nature of this monotonic function for this situation could not be inferred from earlier research.

In an earlier experiment we found that variation of the frequency of pure tones yielded data consistent with the predictions of the linear model of Burke & Estes (1957). Previous experiments in which stimulus similarity has been manipulated, notably Uhl (1964), have employed matrices of lights to provide discriminable sets of stimulus elements. These experiments have not generally supported the linear model, and Uhl's (1964) experiment in particular was most easily interpreted in terms of Estes' pattern model. The discrepancy between our experiments employing auditory discriminative stimuli and those similar to Uhl's employing light matrices probably lies in an artifact of selective attention which is possible in the latter but not the former.

The present study provides information on the feasibility of employing the intensity dimension in experiments which require fairly precise a priori knowledge of the stimulus similarity parameter of mathematical models. In addition, we wished to make certain that there was no effect of stimulus intensity dynamism on choice-response probability which could complicate experimental designs.

Method

The Ss were 120 University of Massachusetts undergraduates, distributed randomly into five groups of 24 Ss. The five groups differed in the value of ΔI which separated the two discriminative stimuli S_1 and S_2 ; the

actual intensity pairings in db SPL were 70-70 ($\Delta I=0$), 70-68 ($\Delta I=2$), 70-67 ($\Delta I=3$), 70-66 ($\Delta I=4$), and 70-64 ($\Delta I=6$). All tones were of 800 cps and were presented together with continuous white noise of 60 db SPL. All auditory stimuli were presented over matched headphones.

Each S was seated before a small Humphreys conditioning board consisting of a 1 in white warning light mounted in the center and 2 in from the top of the panel and two red event lights mounted 4 in above the bottom of the panel and 2 in from either side. Two spring loaded switches were mounted 1 in below each of the event lights. An opaque screen separated adjacent S's.

Each S received a total of 300 trials, 150 trials of each stimulus. Each trial consisted of the presentation of one of the two tones for 2.5 sec., a warning light occurring .43 sec. after the onset of the tone, and a reinforcing light occurring 1.5 sec. after the onset of the warning signal, its duration being .57 sec. Total time per trial was 2.5 sec., and the intertrial interval was a constant 2.5 sec.

The sequence of the 300 trials was randomly chosen with the restriction that there be no more than four S_1 - E_1 or S_2 - E_2 trials in succession, and two different random sequences were employed. The left-hand response switch and light was designated A_1 and E_1 for half of the Ss in each group, and the effect of the position of the more intense stimulus was counter-balanced by designating the right response switch and light A_1 and E_1 for the other half of the Ss in each group.

The Ss were instructed to maximize correct responses, and to respond only during the warning signal. No mention was made of the discriminative aspects of the task.

Results and Discussion

Learning curves showing the proportion of A_1 responses to S_1 and S_2 for each condition of ΔI are presented in Fig. 1. It is evident from the figure that clear differences in discrimination performance among the various ΔI conditions occurred within the first trial-block and were maintained over the remaining trials of the experiments, $F(4,100)=10.27$, $p<.001$. Closer inspection of Fig. 1 revealed that discrimination performance was a linear function of ΔI . Least-squares estimates based on the last trial-block provided the following relationship:

Fig. 1. Proportion of responses in each ΔI condition as a function of trial-block. For $\Delta I > 0$, the more intense tone was arbitrarily designated as S_1 .

$$\text{Proportion Correct Responses} = .059\Delta I + .5 \quad (1)$$

This equation was obtained after group means were shifted by the quantity 2.25% so as to set percentage correct at exactly 50% for $\Delta I = 0$.

The same figures used to obtain equation 1 provide the function relating stimulus similarity to ΔI . The similarity index in question is that given by Burke and Estes (1957) as the parameter ω , namely the ratio of the set-measure of all stimulus elements presented on a trial. In the present experiment, with π values of

1 and 0, and assuming equal set-measure for S_1 and S_2 , the relationship between ω and asymptotic response probability is given by

$$p = 1 - \frac{\omega}{2} \quad (2)$$

From equations 1 and 2 we obtain

$$\omega = 1 - .118\Delta I. \quad (3)$$

The inverse of equation 3 will provide experimenters with the proper values of ΔI for a priori selection of ω as an independent variable or experimental parameter.

$$\Delta I = \frac{1 - \omega}{.118} \quad (4)$$

Thus, a ΔI of 4 db at 70 db SPL using 800 cps tones presented over continuous white noise of 60 db SPL would provide a value of ω approximately equal to .5.

Figure 1 shows that there was no stimulus intensity effects on response choice. In the $\Delta I > 0$ conditions, the more intense tone was arbitrarily designated as S_1 . The figure clearly shows that there was no greater tendency to make the appropriate response to S_1 than to S_2 . This can be seen by the comparative symmetry of the curves about the line $p = .5$. A V-effect would have resulted in an upward shift of all curves.

References

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Note

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