Role of adaptation level in stimulus intensity dynamism¹

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Abstract

Thirty female college students were first adapted to either a 40 db tone, a 100 db tone, or to silence ($N=10$), then given 48 reaction time (RT) trials with randomly ordered presentations of 40, 60, 80, and 100 db auditory signals. RT at all levels of signal intensity was fastest for Ss adapted at 40 db, slowest for Ss adapted at 100 db, and intermediate for Ss adapted to silence. These findings are predicted by Helson's adaptation-level theory but not by Hullian theory.

Introduction

Many investigators (e.g. Beck, 1963; Chocholle, 1945; Gray, 1965) have reported a positive correlation between conditioned stimulus intensity and conditioned response strength. Hull (1949) termed this relationship "stimulus intensity dynamism." Recent experiments by Grice & Hunter (1964) have demonstrated that stimulus intensity effects in classical conditioning and simple reaction time are trivial when intensity is a between-Ss variable, but substantially greater in *absolute terms* when a within-Ss design is employed. Apparently some sort of perceptual contrast effect (rather than a mere increase in statistical precision) results from presenting more than one intensity value to each S. Hull's dynamism postulate fails to predict the Grice and Hunter data, as it assumes that the excitatory strength of a stimulus is constant and based on its absolute intensity. A more adequate explanation is provided by Helson's (1964) adaptation-level (AL) theory. Assuming that the excitatory strength of a stimulus depends on its departure from AL intensity, substantial intensity effects are expected only when S experiences more than one intensity value (within-Ss design), as departures from AL are possible only in that case.

The present experiment was designed to further evaluate the adaptation-level interpretation of stimulus intensity effects. Ss were first adapted to either 40 db tones, 100 db tones, or to silence, then given a series of reaction time (RT) trials with randomized presentations of 40, 60, 80, and 100 db auditory signals. It was assumed that the effective AL during RT trials would be near 40 or 100 db for Ss initially adapted at those levels and near the geometric mean of the test trial intensities (70 db) for Ss adapted to silence. Thus it was expected that mean RTs at all levels of signal intensity would be fastest for the 40 db group (as test signals were at or above AL), slowest for the 100 db group (test signals were at or below AL), and intermediate for the silence group.

Method

The Ss were 30 female undergraduates at the University of Illinois. They were assigned at random to adaptation conditions, 10 Ss to each condition.

The stimulus on both adaptation and test trials was a 1000-cycle tone of 1.5-sec. duration, produced by a Hewlett-Packard model 200 ABR audio oscillator and presented to S via earphones at 40, 60, 80, or 100 db, SPL. The response consisted of pressing a conventional telegraph key. The ready signal was a 10-w light of .5-sec. duration which preceded the tone by 1, 2, or 3 sec. in irregular order on successive trials. The intertrial interval was 15 sec. Temporal parameters of stimuli were controlled by 4 Hunter timers, connected in sequence. RT was recorded in milliseconds by a Hunter model 120A electronic counter.

The experiment was conducted in a soundproof room. Ss who received preliminary adaptation to 40 or 100 db tones were given conventional reaction time instructions, then informed that E wished to insure that the apparatus was working and therefore, before starting the experiment, would present several tones through the earphones. Ss were requested not to press the telegraph key in response to these preliminary tones. The S then received 12 adaptation tones (1.5-sec. duration) at either 40 or 100 db, and at the rate of 3 per min. Ss adapted to silence sat in the soundproof room for a period of 4 min. prior to the onset of RT trials. Following preliminary adaptation the procedure was the same for all Ss. Each S was given 48 RT trials in which 40, 60, 80, and 100 db signals were presented in random order with the restriction that there be four presentations of each intensity value in each block of 16 trials.

Results and Discussion

Figure 1 shows the signal intensity functions of the three treatment groups. It may be noted that all groups showed well-defined intensity curves, and, as predicted by AL theory, mean RT at all levels of signal intensity was fastest for Ss adapted at 40 db, slowest for Ss adapted at 100 db, and intermediate for Ss adapted to silence. The results of a 3 by 4 by 3 (adaptation procedures by signal intensities by blocks of trials) analysis of variance supported the above conclusions. The only significant sources of variation were the main effects of adaptation procedures ($F=4.66$; df 2, 27; $p<.05$) and of signal intensity ($F=162.15$; df 3, 81; $p<.01$). The nonsignificance of the adaptation procedures by signal intensities and adaptation procedures

Fig. 1. Stimulus intensity curves of groups adapted to 40 db. tones, 100 db. tones, and silence.

by trials interaction effects indicate respectively that stimulus intensity functions above and below AL were symmetrical, and that the AL's established by preliminary exposure to extreme stimuli remained stable during RT trials rather than shifting toward the geometric mean of the test signals. Analysis of simple effects revealed that the difference between the intensity curves of the 40 and 100 db groups was significant ($t=3.04$; $df\ 27$; $p<.01$), while neither the 40 or 100 db group differed significantly from the silence group. Finally, the difference between mean RTs of the 100 db group to the 100 db test signal and of the 40 db group to the 40 db signal was nonsignificant ($t=1.43$; $df\ 27$; $p>.20$). This finding is consistent with AL theory as Ss under these two conditions were responding to stimuli of AL intensity, and would therefore be expected to exhibit equal responses strengths.

These findings are consistent with predictions from Helson's theory and suggest further that the excitatory strength of a stimulus depends on its departure from AL, not its absolute intensity as assumed by Hullian theory. Another behavior-theory interpretation of stimulus intensity effects, the Logan (1954)-Perkins (1953)

"contrast hypothesis," also fails to predict the present results. This formulation assumes that the net excitatory strength of a CS depends on how much generalized inhibitory potential it receives from nonreinforced background or intertrial stimuli. A more intense CS has greater excitatory strength because it contrasts more with a zero-intensity background. The Logan-Perkins theory is not readily applicable to the present experiment, as overt reinforcement was not employed. However, if we assume that through transfer from previous learning the auditory signal and its absence (intertrial silence) had excitatory and inhibitory potential respectively at the start of the experiment, the theory predicts no differences among the three treatment groups. The groups did not differ with respect to degree of contrast between signal and background intensity, but performed at different levels.

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Notes

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2. First authorship was decided by the flip of a coin; the two authors contributed equally to the study.