The effect of constant current shock intensities on the acquisition of a discriminated avoidance response¹

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Twenty-seven naive female hooded rats were trained in a lever-pressing situation under a discriminated avoidance procedure in a single 4 hr. session. Different groups received 0.8, 1.6 and 2.8 ma of constant current shock. Analysis of the results showed a slight advantage for Ss trained with a low constant current.

There have been relatively few studies of the effect of shock intensity on the rate of learning a discriminated avoidance response. In some studies a positive relation between intensity of the shock and learning has been found: Kimble (1955) using a wheel-turning apparatus reported that learning increased as a function of current amplitude ranging from 0.2 to 2.0 ma. However, Baettig & Grandjean (1956) found no significant effect due to shock strength (voltage level) in a shuttle box apparatus and Moyer & Korn (1964) report that shock intensities above 1.0 ma interfered with learning, maximal disruption occurring at about 2.5 ma. All these investigators used rat Ss. Brush's (1957) study on dogs in a shuttle box avoidance situation demonstrated a relation between intensity and the percentage of Ss reaching criterion performance; three other measures of performance, viz., rate of acquisition, resistance to extinction and pattern of acquisition failed to discriminate between the different shock intensity levels used.

In the present experiment the rate of learning a lever pressing response under a discriminated avoidance procedure was studied. The procedure eliminated the possibility of the to-be-conditioned response being reinforced by termination of shock (escape learning). The importance of such separation between escape and avoidance contingencies has been emphasized elsewhere (Hurwitz, 1964).

Subjects

The Ss were 27 female hooded rats purchased from the closed colony maintained by the animal laboratories of the Medical Research Council, U.K. They were three months old at the beginning of experimentation and weighed approximately 200 gm. The Ss were randomly assigned to three experimental groups.

Apparatus

The basic apparatus was an all-metal chamber, 12 in. long, 6 in. wide and 9 in. high. The floor of the chamber consisted of five 1/4 in. bars through which shock could be delivered to the S's feet. A stainless steel lever measuring 2 in. wide, .75 in. long and .36 in. thick protruded through one of the walls of the chamber 2.5 in.

above the floor level. This operated a microswitch when pressed with a downward force of 5 gm. Shock was applied to the grid via a scrambler. Two panel indicator lamps mounted on the ceiling, one above the lever and the other at the far side of the chamber, served as signal-lights.

The shock source was a constant-current device with a range of .1 - 5.0 ma.

Procedure

Each S was given one training session lasting for 4 hr. Shortly after an S was placed in the chamber, the signal was presented and unless a lever press occurred within 9 sec., the first of a succession of brief shocks (0.5 sec. on; 5 sec. off) was given. The signal terminated and the train of shocks was suspended only when the lever was momentarily activated. A press during the short shock-on period had no effect. After an interval of 18 sec., the signal and shock series was re-introduced. Group 0.8 received 0.8 ma shock; Group 1.6, 1.6 ma; Group 2.8, 2.8 ma. There were nine Ss in each group.

The number of responses per hour, number of shocks per hour, number of signal-shock terminations or time-outs per hour, the cumulative signal duration per hour and the number of avoidance responses, i.e. the number of responses occurring between signal onset and first shock only, were recorded on event counters.

Results

All measures showed changes as a function of successive hours. However, differences between groups appeared to be negligible on all measures except *number of shocks*. Under the present procedure this measure also appears on logical grounds better than the more commonly used one of per cent avoidance. For example, if an S obtained only a very few number of time-outs per hour, of which, say, half were due to avoidance responses, its per cent avoidance score would be 50%. Yet, this S received more shocks and fewer time-outs than an S responding at a higher rate but producing the same percentage of avoidance responses. Nevertheless in order to make our treatment of data comparable to previous studies both avoidance scores and number of shock scores were submitted to statistical analysis.

Shock-scores. A three-way analysis of variance (Winer, 1962) using the data from all three groups was performed on the number of shocks per hour scores. The group effects were not significant, $F = .3$, $df = 2/24$, $p > .25$, but the group by hour interaction was significant, $F = 3.7$, $df = 6/72$, $p = 0.01$. A check on the homo-

Fig. 1. The figures shown from left to right are: (I) Mean number of shocks obtained by each group as a function of session length. (II) Mean number of shocks obtained and standard deviation of scores for groups receiving 0.8 mA. (III) Mean number of shocks obtained and standard deviation of scores for groups receiving 2.8 mA.

generality of the partitioning of the sums of squares was positive and indicated that there was no change as a function of successive hours.

Avoidance scores. A three-way analysis of variance, using the two extreme groups, groups by hours by subjects on absolute number of avoidance responses showed for groups and for group-hour interaction $F=1.2$, $df=1/16$, $p < .25$; $F=2.7$, $df=3/51$, $0.05 < p < 0.1$ respectively. While the group effect was not significant, there is a suggestive group by hour interaction. For hours $F=11.5$, $df=3/51$, $p > 0.01$ i.e., there was a significant increase in the number of avoidance responses as a function of hours.

Avoidance scores were also tested for trend (Edwards, 1960). This test indicated a significant difference in the curvature of the array of scores for the two extreme shock groups only, Group 0.8 and Group 2.8 ($p=0.5$) (Fig. 1). Using difference scores between successive hours a three-way analysis of variance failed to show any significance between groups except for the hours (session) variable, $F=3.3$, $df=3/51$, $p=0.05$.

Discussion

The development of a special procedure for establishing a discriminated avoidance response (Hurwitz, 1964) in the lever pressing apparatus has made it necessary to identify as many of the critical variables controlling the rate of learning in this situation as possible (D'Amato et al, 1964). The present experiment demonstrates that the intensity of a constant current shock plays only a minor role in determining rate of acquisition. All three groups of Ss, trained with either a 0.8 ma or 2.8 ma pulsed shock, learned to avoid shock by performing the required response within 9 sec. of

signal onset to the same degree. There was some evidence to support the view that Ss exposed to low intensity shock reached the performance plateau earlier than Ss trained under the highest intensity studied (2.8 ma). However, as Fig. 1 indicates, there was a large within-group variance which tends to conceal any effects due to the independent variable. In subsequent studies we will attempt to investigate further the reasons for this large inter-S variance (which is typical of the majority of avoidance learning studies in the literature).

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Note

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