Effects of shock intensity on nondiscriminative avoidance learning of rats in a shuttlebox

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Abstract

Twenty-four rats were given 10 1-hr. sessions in a shuttlebox under conditions of nondiscriminative avoidance training. Half the Ss were trained with a high shock source of 250 v and half were trained with a moderate shock source of 75 v (150,000 ohms in series). Ss trained with 75 v made significantly more avoidance responses and they received significantly fewer shocks than Ss trained with 250 v. High shock intensity led to a general response suppression that was reflected in relatively poor avoidance learning.

Introduction

The present experiment was designed to examine the role of shock intensity on nondiscriminative avoidance learning of rats in a shuttlebox. Until recently it seemed clear that avoidance learning was facilitated by increases in shock intensity, at least up to tetanizing levels of shock. For example, Kimble (1955) found that the mean avoidance latency of a rat to turn a wheel was a decreasing function of shock intensity; Brush (1957) found that the percentage of dogs learning to make a shuttlebox avoidance response increased as a function of shock intensity up to 5 ma; and, in a nondiscriminative avoidance situation, Boren, Sidman, & Herrnstein (1959) found that lever-response rate of rats increased as a function of shock intensity. On the other hand, in a *discriminative* avoidance situation D'Amato, Fazzaro, & Killian (1965) found the percentage of avoidance responses of rats in a lever box was inversely related to shock intensity. The present experiment describes a *nondiscriminative* avoidance situation in which a moderate shock level is considerably more effective than a high shock intensity.

Method

Apparatus. Two shuttleboxes constructed from 1/4 in aluminum (each 15 1/2 in long, 5 1/2 in wide, and 8 in high) were enclosed in sound-resistant boxes. Each shuttlebox had a grid floor of 26 (1/8-in diameter) stainless steel bars, and was divided into two equal compartments by a partition with a 3-in square opening at floor level to permit S to shuttle between the two compartments. The shock circuit consisted of an autotransformer, a power transformer (500 v maximum), and a 150,000 ohm resistor in series with S. The shock was delivered to the input of a Grason-Stadler grid scrambler (Model E1064GSP), the output of which was connected to the bars and the walls of the shuttlebox. To register responses a photocell and light source were inset on opposite walls in each compartment, 1 3/8 in above the floor and 3 in from the partition. Relay control equipment, counters, etc. were located in a separate room.

Subjects and procedure. Ss were naive, female, albino, Norway rats from hysterectomy-derived, barrier-sustained stock, that arrived from Charles River Breeding Laboratories at 150-175 gm (about 7 weeks old). Ss were housed in community cages, given ad lib food and water, and they were handled 4 times per week prior to the beginning of the experiment. The experiment was begun 4 weeks after arrival for 12 Ss and 6 weeks after arrival for the remaining 12 Ss.

Half the Ss were trained at 75 v shock intensity and half the Ss were trained at 250 v intensity. Each S received 10 1-hr. daily sessions. An R-S interval of 20 sec. was employed so that in the absence of shock, S could delay the onset of a shock by 20 sec. if it crossed from one compartment to the other (*avoidance* response). If S failed to make a response in 20 sec. then shock began and it could be terminated only if S crossed from one compartment to the other (*escape* response).

Results

The mean number of shocks (i.e., escape responses) served as an index of efficiency of avoidance responding. In Fig. 1 this index is shown as a function of sessions for the groups trained with the two intensities of shock. The 250-v group received significantly more shocks during the last 5 sessions than the 75-v group (Mann-Whitney U = 1, $p < .001$). There was no significant difference in the mean escape latency during the last

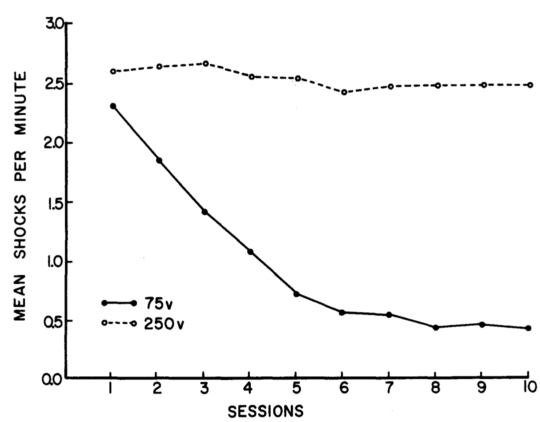

Fig. 1. Mean number of shocks received (i.e., escape responses) per minute as a function of sessions of avoidance training for the group trained with moderate (75-v) shock source and high (250-v) shock source.

5 sessions (0.71 sec. in the 75-v group and 0.73 sec. in the 250-v group).

The mean number of avoidance responses during the last 5 sessions was significantly greater for the 75-v group than for the 250-v group (4.7 responses/min. and 1.4 responses/min., respectively, Mann-Whitney $U=5$, $p<.001$). Furthermore, the temporal distribution of responses was radically different (Fig. 2). Ss in the 75-v group concentrated most of their avoidance responses in the middle of the 20-sec. R-S interval, but Ss in the 250-v group concentrated their responses in one extreme or the other (e.g., modal 2-sec. interval of avoidance response during last 5 days of training of 250-v group had significantly greater range than that of 75-v group, Moses Test, $s'=13$, $p<.001$). The proportion of IRT's less than 2 sec. was significantly greater in the 250-v group than in the 75-v group ($U=6.5$, $p<.001$), but relative to the number of shocks received the groups were equivalent.

To describe the temporal discrimination of Ss in the two groups a conditional probability function (IRT/opp.) was determined for each S during the last 5 days of training, and the mean functions are shown in Fig. 3. The 75-v group clearly demonstrated an excellent temporal discrimination, but the mean function for the 250-v group obscures the fact that, despite considerable overall response suppression, several Ss in the group also had excellent temporal discrimination.

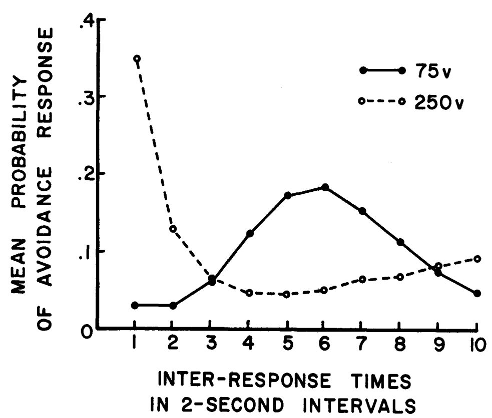

Fig. 2. Probability distribution of inter-response times (IRT's) in 2-sec. intervals for 75-v group and 250-v group.

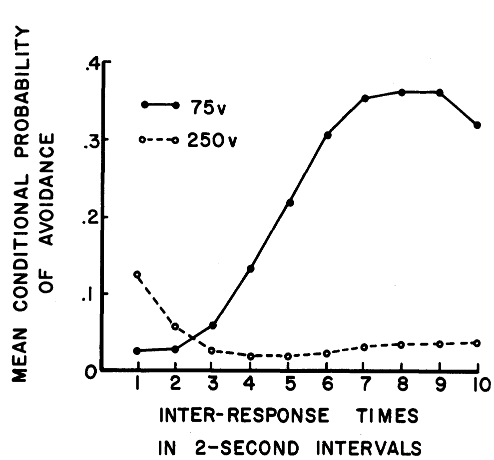

Fig. 3. Conditional probability of inter-response time (IRT/opp.) in 2-sec. intervals for 75-v group and 250-v group.

Discussion

One of the major obstacles to effective avoidance training of rats is that the occurrence of previous shocks, or the threat of subsequent ones, leads to a general response suppression, and such suppression is incompatible with the particular active avoidance response that is being trained. This general response suppression is particularly great at high shock intensities, and it undoubtly accounts for the fact that, under the conditions of this experiment, Ss receiving a moderate 75-v shock were substantially more effective in avoiding the shock than those receiving a high 250-v shock. The poor avoidance performance of Ss trained with high shock probably does not reflect any failure of temporal discrimination, but simply is a result of general response suppression.

References

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Note

1. National Science Foundation Undergraduate Research Participant.