Conditioned suppression in the rat as a function of shock reinforcement schedule¹

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The effects of shock-reinforcement schedules in conditioned suppression were studied in three male albino rats. S_2 (electric shock) was paired randomly with the S_1 either 10%, 50%, or 90% of the time. Each presentation was correlated with a different S_1 (tone, clicker, light). Each S received all three shock reinforcement schedules. Then the S_2 s were presented randomly by days, each with its appropriate S_1 until each S_1 had been presented fifty times in this way. Suppression ratios varied monotonically with shock-reinforcement schedule, with the greatest suppression at 90%. When the S_2 s were presented randomly by days, the greatest variability occurred with the 50% schedule. The results are interpreted in terms of superstitious avoidance behavior.

Estes & Skinner (1941) were the first to publish results on conditioned suppression. Since then there have been several studies of the phenomenon, but few have investigated the effect of pairing the aversive stimulus with a pre-aversive stimulus on an intermittent basis. Geller, Kailan, Stein, & Brady (1957) conditioned three groups of rats each on a 100%, 50%, and 25% shock-reinforcement schedule. They found no difference among the groups in rate of acquisition of the suppression response, but the groups conditioned on the partial schedules were slower to extinguish.

The present experiment was designed to study the effect of partial shock-reinforcement in a within-S design.

Subjects

The Ss were three Carworth CFN male albino rats approximately 160 days old at the beginning of the experiment. Throughout the experiment they were maintained at 80% of the pre-experimental body weight.

Apparatus

A standard commercial chamber and pellet feeder, mounted in a picnic ice box was used. Reinforcement was a 45 mg pellet. S_1 's were a light, a click, and a tone. S_2 was a scrambled 2 sec. 1 ma DC shock. Water was available during each session. The experimental chamber was kept dark except when the S_1 was a light. Bar-press responses were recorded on counters and a cumulative recorder; the number of responses in each S_1 presentation was recorded on a print-out counter.

Procedure

Experimental sessions were run daily at the same time. All three Ss were conditioned to bar press with continuous reinforcement and then switched to a

VI: 1 min. schedule. After this VI responding had stabilized, suppression conditioning was begun. Each S was given 60 conditioning trials (S_1 presentations) at one shock percentage, then switched to a different S_1 and a different shock percentage for 60 more trials, and finally switched to a third S_1 and shock percentage for 60 more trials. These orders were as follows:

S1: tone 90%, clicker 10%, light 50%

S2: tone 10%, light 90%, clicker 50%

S3: tone 50%, clicker 90%, light 10%

After the 180 conditioning trials, the presentation of S_1 's and correlated shock percentages were randomized by days. This procedure was continued until each S had received 50 presentations of each type of S_1 . Throughout the experiment the duration of S_1 was 4 min. and the time between the termination of S_1 on one trial and the presentation of the next S_1 was randomly varied from 4 to 30 min.

The dependent variable, computed for each S_1 presentation was response rate during S_1 minus baseline rate, divided by baseline rate. (Baseline rate was rate in absence of S_1 computed for each session.) A suppression ratio of -1.00 indicated that no responses were made in the presence of the S_1 ; a suppression ratio of 0.00 indicated response rate during S_1 equalled the baseline rate. To estimate the variability of the baseline at the end of the experiment, 50 intervals of 4 min. without S_1 were sampled and a pseudo-suppression ratio computed for each; i.e., the ratio

Fig. 1. Median suppression ratio for 3 animals as a function of trials (in blocks of 10) in the final stage of experimentation at 10%, 50%, and 90% pairing of the S_2 with S_1 . Each plotted point is the median of thirty observations.

Fig. 2. Variability of responding (variance of suppression ratios) in the final stage of experimentation at 0% (baseline), 10%, 50%, and 90% pairing of S_2 with S_1 for 3 animals. Variances are based on 150 observations at each value.

of the difference between the response rate in the sampled 4-min. interval and the baseline rate over the baseline rate.

Results

Figure 1 shows the median suppression ratios (across Ss) in blocks of 10 trials under the terminal conditions. The data for mean suppression ratios were almost identical. There is a monotonic relation between S_2 percentage and median suppression ratio, with the higher percentages related to greater suppression. The Friedman two-way analysis of variance by ranks (Siegel, 1956) was used to estimate the significance of difference between medians under the four conditions (Baseline, 10%, 50%, and 90%). The obtained probability was ($X^2_r = 8.2$, $J = 4$, $K = 3$, $p = .017$). The type of S_1 had no effect on the median suppression ratio ($X^2_r = 0.00$, $J = 3$, $K = 3$, $p = 1.00$). The difference in median suppression ratios due to Ss was also not significant ($X^2_r = 1.50$, $J = 3$, $K = 4$, $p = .653$).

Figure 1 indicates that the median suppression ratios were stable over time at each schedule shock percentage. However, the shock schedule appeared to affect re-

sponse variability as seen in Fig. 2. A Friedman analysis of the difference in variance of suppression ratios due to the different shock schedules did not indicate any significant differences: ($X^2_r = 5.8$, $J = 4$, $K = 3$, $p = .18$).

Discussion

These data are consistent with the findings of Geller, Kailan, Stein, & Brady (1957) in that there is less suppression with the more intermittent shock pairings. Although the differences in variance of suppression ratios due to shock reinforcement schedules were not significant, the trend toward greater response variability in the 50% schedule suggests the possibility that superstitious avoidance behavior is operating. A response can be considered avoidance if it occurs at the end of the S_1 interval which is terminated without the presentation of S_2 . If such behavior is maintained by scheduled shocks, it could be considered superstitious in that the stimulus events are not, in fact, response-contingent.

At the 50% schedule, the median suppression ratio was stable over time (Fig. 1) but tended to show more variability than under the other conditions (Fig. 2). At 50% random pairings there were blocks of S_1 presentations which were not followed by shock. In these intervals, it is possible that the organism was superstitiously learning an avoidance response. However, these trials would be followed by other trials in which the S_2 was presented, and so the avoidance behavior would extinguish. These would be followed by non-shocked trials, during which further superstitious avoidance behavior would occur.

References

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Note

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