Decreased resistance to extinction of a running response following electroconvulsive shock

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Abstract

Three groups of food deprived rats were trained to run down a straight runway to reach dry food. When all rats were running at asymptote, six extinction trials were given. One group received electroconvulsive shock (ECS) immediately following each extinction trial. A second group was given ECS 90 min. following each extinction trial, and the third group received no ECS. The two groups receiving ECS showed significantly faster extinction than the control group, suggesting that ECS possesses aversive properties. In addition, immediate ECS produced faster extinction than delayed ECS.

Problem

There is agreement in the literature that electroconvulsive shock (ECS) administered to rats immediately following a learning trial interferes with learning and retention of an avoidance response; however, the mechanism underlying this interference is still subject to speculation. Some investigators (Duncan, 1949; Glickman, 1961) propose that the ECS effect results from disruption of the neural memory trace of the learning situation before it can be consolidated into long term memory. Others (Coons & Miller, 1960) suggest that a learning deficit occurs because ECS possesses aversive properties that are remembered, become associated with the learning situation, and result in suppression of the learned response.

It is clear that either of these two proposed mechanisms can explain results involving a learning deficit due to administration of ECS. The present experiment was designed such that the data could most readily be explained either by the retrograde amnesia hypothesis, or by the aversive components hypothesis, but not by both. This was accomplished by administering ECS following each of a series of extinction trials, with no ECS being used during initial learning of the response. Thus, if ECS were acting as an aversive stimulus, extinction would take place quite rapidly, since the response would be punished as well as non-rewarded; if ECS were producing retrograde amnesia for recent events, extinction would be prolonged, since the memory lost would be that of an extinction trial.

Method

Twenty-seven male albino rats were given one trial a day for 25 successive days in an enclosed runway measuring 160 cm from start box to goal box. The time required by each rat to traverse the middle 96.5 cm of the runway was measured to the nearest millisecond. On each trial the goal box at the end of

the runway contained 15 Rice Krispies in a small food dish. The Rice-Krispies were readily eaten, since the rats were allowed free access to food each day only for the 45 min. immediately following a trial.

The daily record of running times indicated that all rats were exhibiting asymptotic running times by day 25. The rats were then randomly assigned to three different treatment groups with the restriction that each group contained nine rats. Statistical analysis of the acquisition data indicated that these three groups did not differ from one another either in asymptotic running time or in rate of approach to asymptote.

Six days of extinction training followed the 25 days of acquisition. On each of these six days the rats were given one trial in the runway, but no Rice Krispies were present in the goal box. The three groups of rats received different treatments after they had entered the empty goal box. Group I (immediate ECS) rats were removed from the goal box and within 7 sec. were given ECS on a nearby table. The ECS apparatus consisted of a 2400 volt ac transformer in series with a 45.5 K ohm resistor. ECS was administered by attaching filed down alligator clips to the rat's ears. The shock duration of 200 msec. was controlled by a Hunter Timer. All rats demonstrated the full tonic extensor seizure.

Rats in group D (delayed ECS) were removed from the empty goal box following each of the six extinction trials and returned to the animal colony for 90 min. At the end of 90 min. they were brought back to the experimental room and were given ECS. The third group, group C (control), was treated exactly as group I had been treated, except that ECS was not actually administered. This group provided a measure of the decrement in running speed that could be expected as a function of attaching the ear clip electrodes following an extinction trial.

Results and Discussion

The increases in running time across the six days of extinction are shown in Fig 1. All rats showed significant changes in running speed across days of extinction ($p < .001$). During extinction, any rat that did not leave the start box after 180 sec. had elapsed was prodded down the runway into the goal box and a running time of 180 sec. was recorded. This contrasts with running times of 1 sec. or less achieved by some rats during acquisition.

Between group differences in both linear trend and mean running time were detected by an analysis of

Fig. 1. Mean running time in seconds across days of extinction. A score of 180 sec. would indicate that no animal in a group left the start box without being prodded out.

trend performed on a reciprocal transformation of the running time data ($p < .05$). The Duncan Range test was used to determine which group or groups accounted for these significant differences. It was found that with one exception, all three groups differed from one another in both linear trend and in mean running time ($p < .05$). This one exception was the comparison of groups C and D regarding mean running time. This

difference failed to achieve statistical significance ($p < .10$).

These results suggest that in the present situation ECS acted as an aversive stimulus, tending to inhibit the running response that immediately preceded it. The delayed ECS treatment was significantly less effective than the immediate ECS in suppressing running, but it was more effective than the control treatment, as evidenced by the significant difference in linear trend between groups C and D. There was no evidence that the memory trace of running to the empty goal box was disrupted by ECS, as this would have required that group I show more resistance to extinction than groups C or D.

The superiority of immediate ECS over delayed ECS in inhibiting the running response is not unexpected, since temporal contingency of punishment is quite important in determining the effectiveness of a punisher in suppressing a response.

References

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