Spontaneous recovery of an escape response

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Rats in a shuttle box were reinforced by shock termination on 60 training trials. On the day following the end of training, 30 massed extinction trials were given on which shock termination was delayed for 20 sec following the shuttling response. To test for spontaneous recovery, five additional extinction trials were given after recovery intervals of 5 min, 15 min, 60 min, or 24 h. The results showed spontaneous recovery to be a negatively accelerated monotonic function of the recovery interval. Only a very slight increase in spontaneous recovery was observed when the recovery interval was increased from 60 min to 24 h.

There is considerable evidence that the spontaneous recovery (SR) of responses established with positive reinforcement is a negatively accelerated monotonic function of the recovery interval (e.g., Miller & Stevenson, 1939; Ellson, 1938; and Lewis, 1959). However, there is little evidence to support the generalization of these data to situations involving negative reinforcement. In view of the desirability of studying the influence of certain variables on SR in a situation using negative reinforcement, the present experiment was carried out to measure the SR of an escape response as a function of recovery interval. Following training on a shuttling response reinforced by shock termination, Ss were extinguished and tested for SR after varying recovery intervals.

METHOD

The Ss were 56 male albino rats obtained from the Flying Dutchman Plantation, Memphis, Tennessee. All were experimentally naive and 45 days old at the beginning of the study. They were housed in pairs with food and water available in the home cage at all times.

The shuttle box used had two compartments, each 12 x 6 x 17 in., separated by a guillotine-type stainless steel partition which slid in grooves cut into the walls of the box. A 3½ x 6 in. oval hole cut in the partition was below floor level in the down position. When the partition was raised, the bottom of the hole was 3 in. above the floor, allowing access to the other side of the box. The partition was vertically bisected and the sides insulated from one another for the purposes of electrification. The floor was composed of ¼-in. brass rods spaced approximately ½ in. apart. The two ends and the back of the box were wood and covered with brass sheeting to a height of 9 in. above the floor. The exposed wood was painted brass color. The front side of the box and the lid over each compartment were composed of ¼-in. clear Plexiglas.

Electric shock produced by a Lafayette Model 615A shock generator was delivered to the grid, the partition, and the brass sheeting on the walls through a Lafayette Model A620 scrambler. The S's response latency was timed with a .01-sec timer while the delay of shock termination and the ITI were controlled by Hunter decade interval timers.

Each S received 10 training trials per day for 6 days with a 20-sec ITI separating each trial. The Ss were not run on the week-end and training was omitted on one other day when the power to the building was shut off. The side of the box in which S was placed to start each session was alternated from day to day. On each day, half of the Ss started on one side of the box while the remainder started on the other side. On Days 1-3, 250 V ac were delivered to the scrambler. For the remaining days, this was increased to 300 V. In all cases, a 1-megohm resistor was in the circuit in series with S.

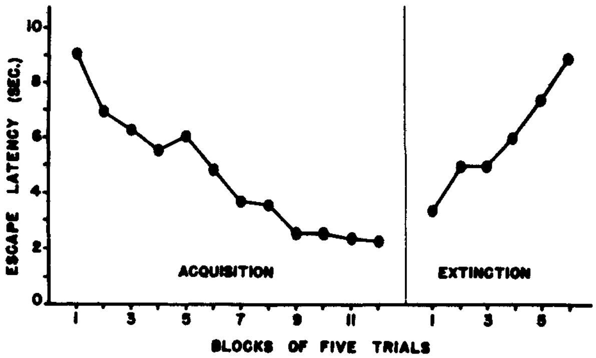

Fig. 1. Mean median escape latencies during training and extinction.

Approximately 20 sec after placing S in the apparatus, the partition was raised. The shock source was activated by a microswitch when the partition was raised ¼ in. When all four of S's feet were on the floor in the other compartment, E pressed a switch which stopped the .01-sec timer and terminated shock. During extinction, this switch activated a timer which controlled the delay of shock termination. If S failed to respond within 60 sec, the partition was lowered, shock was terminated, and S received a score of 60 sec for that trial.

On the day following the end of training, all Ss were given 30 extinction trials on which shock termination was delayed for 20 sec following the response. The ITI remained at 20 sec, measured from the time of shock termination.

Following extinction, the Ss were randomly assigned to one of four SR groups and received five additional extinction trials after recovery intervals of either 5 min, 15 min, 60 min, or 24 h.

This experiment was carried out by three Es, two of whom worked with five randomly selected Ss from each group and one who worked with four randomly selected Ss from each group.

RESULTS AND DISCUSSION

Mean median escape latencies during training and extinction are presented in Fig. 1. Although all Ss were treated alike during these periods, analyses of variance were performed to determine whether Ss later assigned to separate groups were

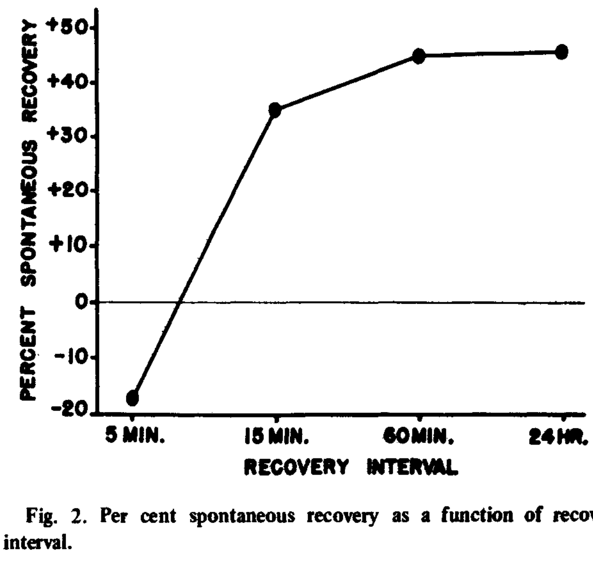

Fig. 2. Per cent spontaneous recovery as a function of recovery interval.

similar. During training, the effects of trial block ($F = 11.92$, $df = 11/524$, $p < .001$) and Trial Block by Recovery interval ($F = 2.48$, $df = 33/524$, $p < .001$) were significant. Although the Trial Block by Recovery Interval interaction was significant, an analysis of the scores on the final five training trials failed to show a difference between Ss later assigned to the separate groups ($F < 1.00$).

During extinction, the following effects were found to be significant: Experimenter by Recovery interval ($F = 2.49$, $df = 6/48$, $p < .05$); trial block ($F = 16.86$, $df = 5/236$, $p < .001$); and Trial Block by Experimenter ($F = 2.88$, $df = 10/236$, $p < .01$). Again, an analysis of the scores on the final five extinction trials failed to show a difference between Ss later assigned to the separate groups ($F < 1.00$). Thus, it seems reasonable to conclude that by the ends of training and extinction, the Ss assigned to the separate groups were all responding at similar levels.

Performance on the SR test is presented in Fig. 2. This figure shows mean per cent SR as a function of recovery interval with SR for each S calculated using the formula E-SR (100)/E. Here, E = median response latency on the final five extinction trials and SR = median response on the five SR test trials. This figure shows the expected negatively accelerated monotonic function with only a slight difference between intervals of 1 and 24 h. An analysis of variance carried out on these data showed the effect of recovery interval to be highly significant ($F = 7.10$, $df = 3/48$, $p < .001$).

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(Continued from page 218)

days to criterion for the respective groups. The major consequence of the PT procedure was prolonged S– periods in the early stages of discrimination training. The mean length of S– periods on the first 3 days of training was 48, 32, and 23 min, respectively.

The present results do not provide evidence of an adventitious S+ reinforcement effect in discrimination learning, confirming the earlier findings of Snow and Uhl (1968). If the change from S– to S+ adventitiously reinforced responding in S– just prior to the stimulus change, Groups PT-Y and ET, for whom there was no programmed delay between responses in S– and the change to S+, should have taken longer to attain the discrimination criterion than Groups PT and TO, respectively. PT-Y Ss averaged 6.3, 3.5, and 2.8 responses in the last 20 sec of each S– period on Days 1, 2, and 3, respectively, of discrimination training. Such responding in S– should have been strengthened by its contiguity with the change to S+ according to the adventitious reinforcement hypothesis, and consequently attainment of the discrimination criterion should have been delayed by the perseveration of responding in S–. A more parsimonious account of the effectiveness of PT, suggested previously by Snow & Uhl (1968), is that the longer S– periods experienced by both PT and PT-Y Ss provided for more complete extinction of S– responding as compared to Groups TO and ET—a massing of extinction in the early stages of discrimination training.

If adventitious conditioned reinforcement due to a change from S– to S+ is a factor retarding discrimination learning, it is a weak and elusive factor. The present results and those of Snow & Uhl (1968) suggest that Kamil & Davenport's (1968) demonstration of an adventitious S+ reinforcement effect may be restricted to the case of a discrete trial discrimination in which primary reinforcement is coincident with the change to S+.

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NOTE

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