Pre- and postreinforcement delay with a small number of acquisition trials¹

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Three groups of rats were given 5 acquisition and 13 extinction trials in a straight alley. Group treatments were: (1) immediate reward (R), (2) 20 sec. delay in goal box followed by reward (D-R), (3) immediate reward followed by 20 sec. nonreinforcement confinement in the goal box (R-D). Groups D-R and R-D were not reliably different but both were more resistant to extinction than Group R. There were no significant differences in acquisition. The data may be explained by a sequential analysis.

One of the problems of the interpretation of delay of reinforcement results is the fact that while partial or varied delay usually leads to greater resistance to extinction than immediate reinforcement (see Renner, 1964, for review) consistent delay has not always produced a detectable effect on extinction. Part of the difficulty may be related to differences in acquisition between consistent delay and immediate reinforcement groups (R). Typically, at terminal acquisition level R groups perform more vigorously than constant delay groups. Where extinction differences have been found they have often been reflected in rate of extinction rather than overall resistance to extinction. One approach to this situation is to begin extinction after a very small number of acquisition trials since there is some evidence (Fehrer, 1956, Experiment II; Marx, McCoy, & Tombaugh, 1965, Experiment 3) that the differences between groups may be very slight early in training.

One of Fehrer's (1956) groups was given 20 sec. consistent delay prior to reinforcement, another 20 sec. confinement in the goal box after reinforcement. Control groups given immediate reward were also run. Both Fehrer's pre- and postreinforcement delay groups were more resistant to extinction than the immediate reinforcement groups. The postreinforcement delay group has received little attention. Two straight alley studies (Cogan, 1966; Vogel & Mikulka, 1966) and one T maze study (Bowen, 1966) have been reported. Vogel and Mikulka's results support Fehrer while Cogan's do not.

Subjects

Ss were 60 90-day-old albino rats of the Wistar strain from the Arlington State College colony. Approximately equal numbers of each sex were used.

Apparatus

The apparatus was a straight alley maze which has been more fully described elsewhere (McCain, 1966, Experiment 5). The only modification for the present study was the addition of a tube in the side of the goal

box so that food pellets could be dropped into the cup at the proper time.

Procedure

Ss were placed on a 23 hr. deprivation schedule on Day 1, removed from colony cages and handled on Days 2-6 and allowed to explore the maze with the feeding tube removed from the goal box on Days 7-9. On Days 10-11 exploration of the maze was continued with feeding tube inserted. On Days 9-12 Ss were given 97 mg Noyes pellets on the handling table before their regular feeding. On Day 12 Ss were randomly assigned to three different groups and placed in individual cages. Groups were designated according to experimental treatment as: (1) immediate reward (Group R); (2) 20 sec. delay in goal box followed by reward (Group D-R); (3) immediate reward followed by 20 sec. nonreinforced confinement in goal box (Group R-D). Ss were placed on a feeding schedule such that they were fed approximately 24 hr. before acquisition.

On Day 13 each S was given four acquisition trials, receiving five 97-mg pellets on each trial. Ss ran in squads of three with one S from each group assigned to a squad. Running order within squads was determined by taking all possible orders of three groups and randomly assigning an order to each squad, restricted only by the requirement that all orders be used before repeating any order. Each S in a squad received a single trial and was then returned to a waiting box. Any animal requiring 30 or more sec. to reach the goal box was guided and assigned a maximum time. Any S taking 30 or more sec. on three acquisition trials was to be removed from the experiment. No S was lost due to this stipulation.

On Day 14 Ss were given one acquisition trial followed by 13 extinction trials. Any S requiring more than 30 sec. to reach the goal box on the first extinction trial was to be discontinued. No S was lost on this basis. Ss were retained in the goal box for 20 sec. on extinction trials. Any S requiring more than 45 sec. to reach goal box after first extinction trial was guided and given the maximum time.

Results and Discussion

Times were transformed by taking a logarithm of the time in seconds + 1. Figure 1 shows the mean transformed times for individual acquisition trials (A) and for the first extinction trial (E^1). E^1 is not plotted nor analyzed with the E-trials since running time is taken before the S experiences nonreinforcement. Extinction data are based on transformed medians from

Fig. 1. Mean transformed running times on individual acquisition trials and means of medians from blocks of three extinction trials.

blocks of three trials. As may be seen from the figure, there is no apparent difference between the groups during acquisition. An analysis of variance of all A-trials confirms the appearance ($F < 1$). The terminal acquisition level is of particular interest in view of past results; again, whether A^5 or a combination of A^5 and E^1 is analyzed, there is no significant difference ($F < 1$ in each case). There is an overall groups difference in the extinction phase ($F = 3.32$, $df = 2/54$, $p < .05$). Individual t tests indicated that both Group D-R ($t = 2.52$, $df = 36$, $p < .02$) and Group R-D ($t = 1.76$, $df = 36$, $p < .10 > .05$)² were more resistant to extinction than Group R. The difference between Groups R-D and D-R was slight ($t < 1$). Comparisons on some other trial groupings gave significant ($p < .05$) differences between Groups R-D and R.

These results lend support to Fehrer's (1956) findings regarding pre- and postreinforcement delay groups. One exception appears to be the relation in extinction between the pre- and postreinforcement delay groups. In the present study these groups (R-D and D-R) are not significantly different. Fehrer did find a difference. The present study also demonstrates the possibility of manipulating delay variables using a small number of acquisition trials. The absence of terminal acquisition differences simplifies analysis of the extinction data.

Fehrer (1956) interpreted her results in terms of an expectancy hypothesis. The present results do not necessarily contradict such a notion. An alternative explanation is compatible with a sequential hypothesis as stated by Capaldi (in press). In Capaldi's analysis, delay and nonreinforcement form a continuum

with longer delays more closely resembling nonreinforcement. It is further assumed that a portion of the stimulus complex on any particular trial is a product of the previous trial. Thus the stimulus consequences of delay of reward (S^D) from each delay trial would be present on the succeeding trial and would acquire some measure of associative strength. In the present study the delay groups, in which S^D had been associated with the locomotion response, were expected to be more resistant to extinction than the group in which S^D had not been present during acquisition. This was attributed to the presence of the stimulus consequences of nonreinforcement (S^N) in extinction. Presumably, some measure of associative strength would generalize from S^D to S^N resulting in greater resistance to extinction for Groups R-D and D-R.

For the present pre- and postreinforcement delay are treated as if they produce stimulus consequences which are functionally the same in extinction. Evidence from the present study and two recent unpublished studies from our laboratory do not provide a basis for discriminating between these two delay conditions.

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Notes

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2. This was erroneously reported as $p < .05$ in the Psychonomic Society paper.