Influence of partial reinforcement pattern and intertrial reinforcement on extinction performance following abbreviated training¹

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The resistance to extinction of albino rats was investigated as a function of N-R, R-N, and R-R transitions with abbreviated training in a runway. The relevance of the results to the modified aftereffects hypothesis was discussed.

The present investigation was one of a series of studies which has generally been concerned with the interaction of various partial reinforcement trial sequences with level of training in determining the resistance to extinction of albino rats in instrumental reward learning situations.

Earlier experiments have found extinction performance to be an increasing function of nonreinforced-reinforced trial sequences (N-R transitions) with both abbreviated (Spivey, 1967) and extended (Spivey, Hess, & Klemic, in press) training. Spivey, Hess, & Aponte (in press) found that N-length (the number of uninterrupted N trials immediately preceding an R trial) greatly influenced extinction performance following abbreviated training. This result agrees with previously reported extended training results (Gonzalez & Bitterman, 1964; Capaldi, 1964; Capaldi & Stanley, 1965).

Two other types of trial sequences, R-N and R-R, may not prove to be equally potent for both small and large numbers of training trials. Spivey, Prada, & Black (1967) found with extended training that R-N transitions decreased the resistance to extinction of an operant response, while Spivey, Hess, & Aponte (1967) found following abbreviated training in an alley that resistance to extinction was an increasing function of number of R-R transitions. However, it is expected that number of R-R transitions has a relatively weak effect, as compared to that of the other trial sequence variables, since R-R transitions result only in *generalized* associative strength for the actual test stimulus, the aftereffect of nonreinforcement (S^N). Thus, with extended training the comparative influence of N-length might be so great as to override any effects of R-R transitions. Conversely, R-N transitions may need to be considered only when large numbers of training trials are involved (Spivey & Hess, in press; Spivey, Prada, & Black, 1967).

A recent investigation (Spivey & Hess, in press) attempted to ascertain the relative influence of N-R, R-N, and R-R transitions on the extinction performance of rats following abbreviated training. Unfortunately, the results may have been confounded by the occurrence of N-R transitions across a 24 h intertrial interval for one of the groups. The present

study constituted a replication of the Spivey-Hess experiment, except that the last trial of each day of acquisition was followed by a reinforced placement. It was assumed that the placement would prevent the conditioning of the aftereffect of nonreinforcement (S^N) between days (Capaldi & Spivey, 1964).

Method

The Ss were 36 naive, 90 day old, male albino rats of the Sprague-Dawley strain, supplied by the Holtzman Co. of Madison, Wisconsin. Twelve Ss were randomly assigned to each of three groups.

The apparatus was the wire-topped plywood runway, measuring 75 in. long x 4 in. wide x 9 in. high and terminating with a two-compartment aluminum food cup, that was used in the previous investigation (Spivey & Hess, in press). Running times over a 60 in. distance were computed by summing the alley and goal section times which were recorded on Standard Electric timers connected to a 10 in. floor treadle and to two photocells located 48 in. and 60 in. beyond the treadle. The food cup lid was automatically retracted when S passed the last photobeam.

After three days of ad lib food, the 23 h food deprivation schedule was initiated (Day 1 of training). As in the previous study (see Spivey & Hess, in press) Ss were handled on Days 10-13, were given R placements in the goalbox (GB) on Days 14 and 15, and were given one R running trial on Days 16 and 17. Beginning on Day 16, if S did not complete a section of the alley within 60 sec S was gently forced into the GB, and 60 sec was recorded for each uncompleted section.

On each of the three days of acquisition, Days 18-20, four running trials were given according to one of the following patterns: NNRR (Group N-R), RRNN (Group R-N), or RRRR (Group R-R). On R trials S was confined to the GB for 15 sec with the food compartment containing wet mash; on N trials S was confined for 15 sec with the empty food compartment while wet mash was present, though not visible, in the adjoining compartment. The 15 sec period between trials was spent in the 12 in. sq x 24 in. deep unpainted wooden intertrial interval (ITI) box. Following the last trial on each of the three days of acquisition each S: (1) was given the normal 15 sec ITI box confinement, then (2) was placed by hand in the GB as close as possible to the open, baited food cup, and after 15 sec, (3) was removed and given another 15 sec confinement in the ITI box before being returned to the home cage.

Fig. 1. Group mean log running time in extinction. Trial R was reinforced and Trials 1-13 were nonreinforced.

On Day 21 an initial R trial was given and was followed by 13 N trials. The extinction procedures were identical to those of acquisition, including the presence of wet mash in the adjoining compartment, except that no placements were given. If an S failed to complete the alley section within 60 sec on three successive trials, that S was considered extinguished, and 60 sec was assigned for both the alley and goal sections for each of the remaining trials.

Results

The group mean log running times in extinction are shown in Fig. 1. All analyses were performed on the individual S log running times. The groups did not differ on the initial trial of either acquisition or extinction ($F < 1$ and $F = 1.00$, $df = 2/33$, respectively). An analysis of variance applied to the mean log running times for each S for N Trials 2-13 revealed that the group differences exceeded the .001 level of significance ($F = 13.29$, $df = 2/33$). Duncan's multiple range test (Edwards, 1960) further indicated that Group N-R ran faster than either Group R-N or R-R ($p < .001$ for each comparison); Groups R-N and R-R did not differ ($p > .10$).

A repeated measures analysis of variance applied to N Trials 1-13 indicated that the Groups by Trials interaction was highly significant ($F = 2.01$, $df = 24/396$, $p < .01$). Similar analyses applied to the different group pairings revealed that Groups R-N and R-R did not differ ($F < 1$, $df = 12/264$), while Group N-R extinguished at a slower rate than either Group R-R or Group R-N ($F = 2.77$, $df = 12/264$, $p < .005$; $F = 3.17$, $df = 12/264$, $p < .001$, respectively).

Discussion

In the previous investigation (Spivey & Hess, in press), Group N-R was most resistant to extinction while Groups R-N and R-R did not differ. The finding in the present study that N-R transitions was again the major variable determining extinction performance was expected. On the other hand, the similar extinction performance of Groups R-N and R-R in the present experiment

was surprising. Even if R-N transitions have no effect with abbreviated training, Group R-N still should have been less resistant to extinction than Group R-R since the latter group received more R-R transitions. Also, while the similar performance levels of Groups R-R and R-N in the Spivey-Hess study may have been due in part to the conditioning of S^N between days for Group R-N, the ITRs in the present investigation should have prevented such conditioning.

A possible solution to this dilemma is presented by the recent finding of McCain & Brown (1967) that an ITR may act to reinforce S^N . Thus, it may be that the N-ITR transitions for Group R-N offset the advantage that Group R-R had in receiving extra R-R transitions. This interpretation is admittedly ad hoc and is only presented as one possible explanation for the results.

It is also possible that partial reinforcement training, even if devoid of N-R transitions, may somewhat increase resistance to extinction. However, this alternative view does not seem to be in accord with the available evidence (see Capaldi, 1967).

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