Effect of several reward exposure procedures on the small trial PRE[1]

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Rats were run in a straight alley runway for five acquisition and 10 extinction trials. Partial reinforcement led to greater resistance to extinction than consistent reinforcement. The PRE evaluated in terms of mean extinction speed was greater for animals receiving exposure to the experimental apparatus prior to acquisition (either rewarded or nonrewarded placements) than for animals not receiving such exposure. The PRE evaluated in terms of rate of extinction did not differ across the three reward exposure conditions. The implications of these results were considered within the context of the frustration hypothesis.

Several recent studies (Capaldi, Lanier, & Godbout, in press; McCain, 1966; Surridge, Rashotte, & Amsel, 1967) have attempted to determine if a partial reinforcement extinction effect (PRE) can be obtained following a limited number of acquisition trials (e.g., five or fewer). All such investigations have employed restricted reward exposure procedures, allowing no exposure to reward in the experimental situation prior to the first acquisition trial. The assumption seems to be that the more usual procedure (e.g., rewarded goal box placements) might facilitate the occurrence of a small-trial PRE. In order to determine the role of prior reward exposure on the small-trial PRE, the present investigation varied both the amount (zero to four goal box placements) and type (rewarded vs nonrewarded goal box placements) of exposure to the experimental situation prior to acquisition training.

Previous discussions (Moltz, 1957; Stein, 1957) have proposed that goal box placements influence the fractional anticipatory goal response (r_g). Moltz suggests that nonrewarded goal box placements serve to extinguish the tendency for the goal box cues to elicit r_g and, therefore, reduce the strength of r_g. Stein suggests that rewarded goal box placements serve to condition r_g to the goal box cues and, therefore, increase the strength of r_g. If it is assumed that the strength of r_g is increased by rewarded placements and decreased by nonrewarded placements, then the present investigation seems relevant to the frustration hypothesis (e.g., Amsel, 1958). According to the frustration hypothesis, the PRE occurs only after the learning process has passed through several successive stages. Concern here will be directed to the initial stage, that of increasing the strength of r_g to some critical level. The different reward exposure procedures employed in the present investigation can be assumed to influence the progress through this initial stage. If it is assumed that rewarded goal box placements (R) increase the strength of r_g, then such placements should facilitate the occurrence of the PRE, relative to a control condition (C) which receives no exposure to the experimental situation prior to acquisition training. On the other hand, nonrewarded goal box placements (N) may reduce the strength of any r_g generalized to the goal box from extra-experimental situations (e.g., the home cage). Thus the N condition should be less likely to produce a PRE than the C condition. In summary, if the above assumptions are made concerning r_g, then the frustration hypothesis would appear to predict the greatest PRE for the R condition and the smallest PRE for the N condition, with the C condition intermediate.

METHOD

Seventy-two 90-day-old male rats, obtained from the Holtzman Co. in Madison, Wisconsin, were run in a straight alley runway identical to that described by Capaldi et al (in press). The alley included 14-in. start, 52-in. run, and 16-in. goal sections. A guillotine door allowed confinement of the S in the goal section.

During the 22-day period preceding experimental training, Ss were handled, adjusted to a 12-g daily ration, and given experience eating .045-g Noyes pellets in the home cage. In order to dissociate handling and feeding, the E who always handled the Ss was ungloved, while the second E who always fed the Ss their daily ration and Noyes pellets in the home cage wore surgical gloves. Prior to experimental training, Ss were never fed less than 30 min following handling and were never handled at feeding time.

Experimental training consisted of one day of reward exposure training, followed by two days of acquisition trials and finally one day of extinction trials. For reward exposure training, Ss were divided into three equal groups (N = 24) which received either four rewarded goal box placements (R), four nonrewarded goal box placements (N), or four nonrewarded placements in a "neutral" wire box (C). On the first day of acquisition, all Ss received a single rewarded running trial. The second day of acquisition, one half of each of the placement groups received consistent (100%) reward while the other half received partial (50%) reward according to the following schedule: $- + - +$. The resulting six experimental groups (N = 12) comprise a 2 by 3 factorial design with two levels of reward schedule on the second day of acquisition (50% vs 100%) and three levels of prior reward exposure (N, R, and C). Individual groups will be referenced by a letter referring to the treatment during the reward exposure phase and a number referring to the reward schedule of the second day of acquisition, e.g., Group C-50. The last day of experimental training was the extinction phase, consisting of 10 nonrewarded running trials.

On all rewarded goal box placements and running trials, the goal cup was baited with 24 .045-g Noyes pellets, and the S was removed immediately after eating. On nonrewarded placements, the S was removed from the goal box or wire box after a 1-min confinement, the approximate time required to consume 24 pellets. On nonrewarded running trials, the S was confined to the goal box for 30 sec. The Ss were run in squads of six, one S from each of the six experimental groups, with a resulting intertrial interval of 6 to 8 min. One S in Group C-100 died during the course of the experiment.

RESULTS

Separate speed measures (reciprocal time) were obtained and analyzed for each of the three alley sections.

Acquisition Trial 1

The only significant effects on the first trial of acquisition were attributable to the reward exposure variable. Rewarded goal box placements (R) led to faster running than nonrewarded goal box placements (N) in the run ($F = 8.06$, $p < .01$) and goal ($F = 6.60$, $p < .05$) sections. Performance in the control condition (C) was inferior to that of the N condition in all three alley sections (start–$F = 8.61$, $p < .01$; run–$F = 10.04$, $p < .01$; goal–$F = 8.09$, $p < .01$), indicating a facilitative effect of prior exposure to the experimental apparatus–even if that exposure did not include reward.

Extinction Trial 1

Extinction Trial 1 may be considered the terminal acquisition trial (see Fig. 1). Schedule of reward had a significant effect on extinction Trial 1 only in the goal section,

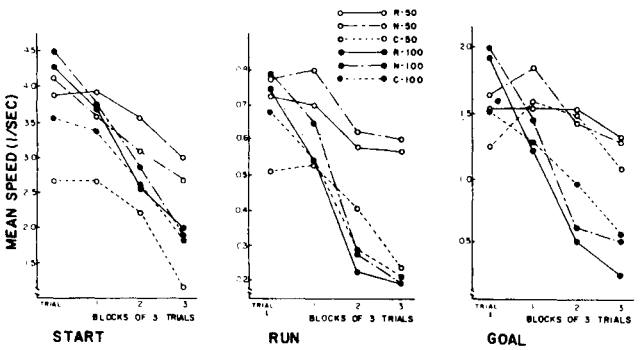

Fig. 1. Mean extinction speeds for the six experimental groups on the first trial of extinction and on the remaining nine extinction trials in blocks of three trials.

with 100% reward leading to significantly faster running than 50% reward ($F = 13.06$, $p < .001$). The previous difference between the R and N conditions had disappeared ($F < 1.0$ in all three sections). In all alley sections, performance in the C condition remained significantly depressed relative to that in the R and N conditions (start–$F = 5.91$, $p < .05$; run–$F = 12.25$, $p < .001$; goal–$F = 14.65$, $p < .001$). The reward schedule by reward exposure interaction was not significant in any of the alley sections.

Extinction Trials 1-10

Extinction performance for each of the six experimental groups is presented in Fig. 1. In investigations of the PRE employing extended training (e.g., Weinstock, 1954), the partially rewarded group demonstrates both a slower rate of extinction and superior mean extinction speed, relative to the consistently rewarded group. To statistically test the difference in rate of extinction, the relevant Groups by Trials interaction over the 10 extinction trials was used. The Reward Schedule by Trials interaction was significant in the run ($F = 6.08$, $p < .001$) and goal ($F = 13.52$, $p < .001$) sections, indicating a slower rate of extinction for the 50% groups relative to the 100% groups. The effect of reward schedule on rate of extinction did not interact with type of reward exposure training. Reward schedule also had a significant effect on mean extinction speed, with 50% leading to superior performance in the run ($F = 14.78$, $p < .001$) and goal ($F = 40.48$, $p < .001$) sections. The PRE in terms of overall extinction performance did not differ in the N and R conditions, but in the run section the PRE evaluated in this way was greater for the N and R conditions than for the C condition ($F = 6.15$, $p < .05$).

DISCUSSION

One result of this investigation was that a PRE occurred after only five acquisition trials in the run and goal sections but not in the start section, regardless of whether resistance to extinction was evaluated in terms of overall extinction performance or rate of extinction. In a previous investigation employing only five acquisition trials, Capaldi et al (in press) found a significant PRE in the run and goal sections but not in the start section. However, Wagner (1961) found a PRE in all alley sections after either 16 or 60 acquisition trials. Consideration of these results after 5, 16, or 60 acquisition trials suggests that the PRE will be found in regions close to the goal after limited training but in regions farther from the goal only after more extensive training.

If as previously indicated the frustration hypothesis expects a larger PRE in the R condition than in the remaining reward exposure conditions, then that hypothesis is not supported by the present results. The PRE may be defined either in terms of mean speed differences in extinction or in terms of relative speed decline over extinction trials (rate of extinction). By either criterion the PRE was similar in the R and N conditions. However, an examination of the results for the C condition suggest additional difficulties for the frustration view. In terms of the rate of extinction criterion the PRE in the C condition did not differ from that in the other reward exposure conditions in any alley section. By the mean speed criterion the type of reward exposure did not affect the size of the PRE in the goal section, but in the start and run sections the PRE was smallest in the C condition. A glance at Fig. 1 will show that the three C-50 curves are similar in shape to the curves for the partial groups in the other reward exposure conditions, but in the start and run sections the C-50 group differed from the remaining partial groups mainly in running slower at the beginning of extinction, a tendency which persisted throughout extinction. This suggests that the major effect of prior reward exposure was not on the rate of extinction but rather on mean extinction speed.[2]

The significantly faster running in the R condition than in the N condition on the first acquisition trial supports Stein's (1957) hypothesized relationship between placements and r_g and, within the context of that hypothesis, indicates that the pretraining procedures employed were effective in manipulating r_g. Considering the results for the first acquisition trial, it is difficult to attribute the similarities of the R and N PREs to a failure to manipulate the strength of r_g.

The faster running on the first trial of acquisition of the N condition relative to the C condition is not consistant with Moltz's (1957) hypothesis concerning the effect of nonrewarded placements on r_g. However, this discrepancy could be interpreted as implying that the extinction of generalized r_g afforded by nonrewarded placements is more than compensated for by factors which may facilitate subsequent alley performance–such as fear reduction.

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NOTES

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2. To further determine the effect of reward exposure on the PRE in terms of rate of extinction, an Anderson rate transformation (Anderson, 1963) was performed on the extinction data. The resulting group means were analyzed as a 3 by 2 factorial design. In no alley section was there a significant Reward Exposure by Reward Schedule interaction, indicating that the differences in rate of extinction due to the reward schedule variable did not vary with type of reward exposure.