Secondary reinforcement effects of placement procedures in a runway situation[1]

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In Experiment 1 rats were given (a) differentially, (b) nondifferentially, or (c) nonrewarded placements interpolated among nonrewarded runs. Differential placements produced significant increments affecting only start speeds. In Experiment 2 prior continuously- or partially-rewarded placements each produced significant increments in goal speeds, but not in start speeds, and did not differ in their secondary reinforcing effects.

Rewarded goal box (GB) placements offer a method for establishing GB cues as positive secondary reinforcers. In a test, Ss so trained should acquire an instrumental approach response in a runway using the empty GB as a reinforcer more readily than would suitable controls. Experiments 1 and 2, reported herein, used the foregoing method.

EXPERIMENT 1

Experiment 1 was designed to test whether (a) differentially, and (b) nondifferentially rewarded placements interpolated among nonrewarded trials have secondary reinforcing effects and if they differ in the amount of this effect. Differentially rewarded placements were contrasted with nondifferentially rewarded placements in view of the discriminative stimulus hypothesis of secondary reinforcement (Keller & Schoenfeld, 1950). According to this hypothesis, a stimulus is an effective secondary reinforcer only if it has become a discriminative stimulus for a response (which in the case of placements is minimally instrumental).

METHOD

Subjects

The Ss were 30 male albino rats, which were 70 to 80 days old when received from the Holtzman Company.

Apparatus

The apparatus was a short (30½-in.) wooden runway, 5½ in. in cross section. It had a gray 8-in. start box (SB), a gray 10½-in. runway section, and two 12-in. side-by-side boxes. One box was white and served as a goal box (GB); the other was black and served as a placement box (PB). Guillotine-type gates separated the three runway segments. A gray cloth curtain prevented S from seeing the GB before beginning entry.

Responses were timed with the aid of two photoelectric relays and .01-sec clocks. Clock 1 measured the interval from E raising the start slide to S interrupting a light beam which was 8 in. down the runway and 2½ in. from the goal slide. Clock 2 measured goal time, the time to traverse the next 10½ in. to within 4 in. of the end of the GB. In both the GB and PB there was a 2-3/8 in. glass caster, painted the same color as the GB or PB, and centered at the far end. The casters served as reward cups.

Procedure

After four days of ad libitum feeding, handling, and adaptation to the laboratory, Ss were placed on food deprivation, and thereafter were fed 12 g of Purina lab chow at least 15 min after the daily experimental sessions with feeding adjusted to take reward intake into account. Pretraining (eight days) consisted of handling, rewarded placements (four 97-mg Noyes tablets) using a gray food cup in a gray 10 x 10 x 10 in. neutral box with a wire mesh floor, exploration in the runway, and four nonrewarded runs to the GB.

In Phase 1, placement training, the 30 Ss were randomly divided into three groups of 10 each. For 26 days each S was given three trials per day, the first being a nonrewarded running trial and the following two, placement trials. On each day, Group D (differentially rewarded) Ss were given one rewarded placement in GB and one nonrewarded placement in PB, Group ND (nondifferentially rewarded), a rewarded placement in each box, and Group C (control), a nonrewarded placement in each box. The intertrial interval was at least 30 min, and the reward, whenever given, was four 97-mg Noyes tablets. The order of GB and PB placements was individually randomized.

On a running trial, S was taken from his cage and put into the SB. After counting to three, E raised the start slide. This slide was lowered when S broke the first beam, and the goal slide was lowered when S broke the second beam. S was removed from the GB 20 sec after entry and was returned to his cage.

On a placement trial, S was taken from his cage and put in either the GB or PB with his head facing and directly over the caster so as to truncate the instrumental approach sequence. On rewarded occasions, S was removed from the box after taking the last tablet into his mouth—on nonrewarded occasions, after 20 sec.

In Phase 2, acquisition, each S was given six rewarded runs (at one trial per day) without any placements to determine whether the placement procedures of Phase 1 would differentially affect acquisition under reward conditions.

RESULTS

Clock 1 and Clock 2 times were transformed to reciprocals (x 100) in order to obtain start and goal speed scores, respectively. Subject means were then found for four Phase 1 six-trial blocks (beginning with the third trial) and for one five-trial block of Phase 2 (beginning with the second trial). Fig. 1 shows the group means. A trend analysis of variance of the Phase 1 start speed data yielded one significant F, that for Treatments ($F = 5.53$, $df = 2/27$, $p < .01$). Subsequent t-tests showed that the Group D and ND means were significantly ($p < .05$) larger than Group C mean, but did not differ from each other. A parallel analysis of variance of goal speeds yielded significant effects for Treatments ($F = 4.00$, $df = 2/27$, $p < .05$) and for Trial Blocks ($F = 8.34$, $df = 3/81$, $p < .01$). Subsequent t-tests showed that the mean for Group D was significantly ($p < .05$) greater than that for Group C, while

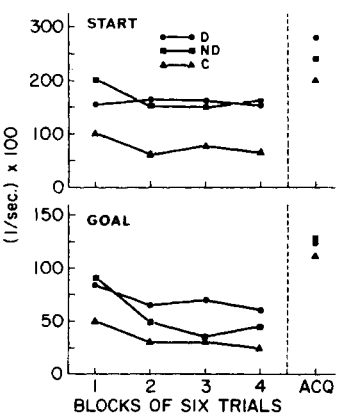

Fig. 1. Mean start and goal speeds during interpolated placement training and the final acquisition phase of Experiment 1.

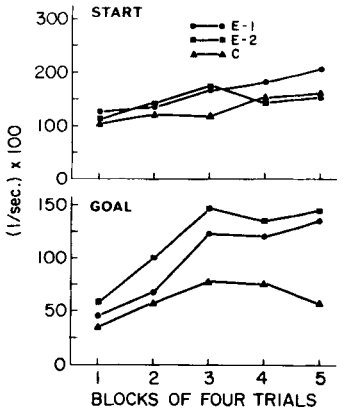

Fig. 2. Mean start and goal speeds in Experiment 2.

other group differences were nonsignificant. As shown in Fig. 1, the goal speed curves of all three groups tended to decline after the first trial block, especially in the case of Group ND. The F for Groups by Trials, however, was nonsignificant.

Fig. 1 shows that in Phase 2, rewarded acquisition, Group D and ND start and goal means in Phase 2 were larger than those of Group C. The Fs for Treatments, however, fell short of significance.

EXPERIMENT 2

Saltzman (1949), D'Amato, Lachman, & Kivy (1958), and Klein (1959), using runway training followed by a two-choice learning test, found that GB cues become more effective secondary reinforcers if associated with intermittent reward than with continuous reward. Experiment 2 was designed to test for the secondary reinforcing effects of intermittently vs continuously rewarded GB placements upon subsequent runway behavior.

Subjects

The Ss were 39 female albino rats. They were 85 days old when received from the Holtzman Co.

Apparatus

The apparatus and maintenance conditions were the same as those of the preceding study.

Procedure

Pretraining procedures were identical with those of Experiment 1. The experiment proper consisted of a placement and a test phase. In the placement phase each S was given 16 GB placements (at one per day). The Ss were randomly assigned to three groups, each having 13 Ss. Group E-1 (continuously rewarded) Ss were given a rewarded placement on every trial, Group E-2 (partially rewarded), on every other trial, and Group C (control), nonrewarded placements. Reward, whenever given, consisted of 10 97-mg Noyes tablets. On a nonrewarded trial S was kept in the GB for 45 sec.

In the subsequent test phase, each S was given 21 nonrewarded runs (at one per day) to the GB, where he was retained for 20 sec before being returned to his home cage. Placements were not given in this phase.

RESULTS

Clocks 1 and 2 times were transformed to start and goal speed scores as before, and subject means were determined for five four-trial blocks (beginning with Trial 2). Fig. 2 shows the group means for start and goal speeds. In a trend analysis of variance of start speed data, a significant effect was obtained only for Trials ($F = 6.34$, $df = 4/144$, $p < .01$). As shown in Fig. 2, mean start speeds tended to increase over trials. A parallel analysis of variance of goal speed data yielded significant effects for Treatments ($F = 7.29$, $df = 2/36$, $p < .01$) and for Trials ($F = 23.08$, $df = 4/144$, $p < .01$). In t-tests comparing group means, the Group E-1 and E-2 means were significantly ($p < .05$) greater than the Group C mean, but not different from each other. Fig. 2 shows that mean goal speeds tended to increase over trials, apparently more in Groups E-1 and E-2 than in Group C. The Treatments by Trials interaction, however, was only marginally significant ($F = 1.82$, $df = 8/144$, $p < .10$). A more powerful analysis of variance of the linear component of trend yielded a significant Treatment by Trials interaction ($F = 3.62$, $df = 2/144$, $p < .05$).

DISCUSSION

The findings regarding goal speeds suggest that various placement procedures may establish GB cues as positive secondary reinforcers. Placement training, however, may associate a truncated approach response to cues in the immediate region of the goal, and this response may generalize to antedating runway cues in the test. Thus, the cue and secondary reinforcing effects of a stimulus (Wyckoff, Sidowski, & Chambliss, 1958) may be confounded in the GB. The increment in start speeds found in Experiment 1 appears to be stronger evidence of secondary reinforcement, although an associative explanation is not wholly ruled out. It is not known why a similar effect was not obtained in Experiment 2.

The findings in Experiment 1 were negative in regard to the discriminative stimulus hypothesis of secondary reinforcement, which is in agreement with the weight of the evidence reviewed by Wike (1966). The findings in Experiment 2, in contrast to those previously cited, were negative in regard to the hypothesis that partially rewarded placements have stronger secondary reinforcing effects than do continuously rewarded ones.

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NOTES

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2. Now at the University of Texas Southwestern Medical School at Dallas.