Differential conditioning and subsequent choice: Partial vs. continuous reward¹

H. WAYNE LUDVIGSON

THE UNIVERSITY OF TEXAS SOUTHWESTERN MEDICAL SCHOOL

Three groups of rats received 0, 48, or 138 differential conditioning trials in which 50% of the responses to one cue were rewarded and 100% of the responses to the other cue were rewarded. With extensive training speeds to the 50% cue exceeded those to the 100% cue in starting and running segments of the alley, while the reverse relationship obtained in the goal-entry speeds. Subsequent choice of cues was little affected by the differential conditioning.

Amsel et al (1964) found that rats' asymptotic starting and running speeds eventually were faster when confronted with a discriminandum or cue associated with partial (50%) reward as compared with continuous (100%) reward. However, this effect, which duplicates within Ss a relation previously found to obtain between Ss (Goodrich, 1959), was not observed by Pavlik et al (1965). The present research sought to replicate these differential conditioning findings and determine what effect establishing such differential response strength has on behavior when S is subsequently permitted to choose the cue to which to respond.

Only the second of two studies is detailed below since the first failed to produce differential speeds to the two cues. A possible reason for this failure is discussed.

Method

The Ss were 48 female albino rats, 72 days old at the beginning of the study. The apparatus consisted of a sliding, grey startbox (SB) and four, juxtaposed, straight alleys, two painted flat white and two black. The SB could be situated such that S was confronted with one of two pairs of alleys, with either a white alley to his left and a black alley to his right or vice versa. The apparatus was 4 in. high covered with clear Plexiglas throughout. Alleys were 38.5-in. long and 3.5-in. wide except for the first 7 in., in which the outside walls of each pair of alleys narrowed toward the median until they were 2 in. apart where they met the SB. The first 7 in. of the median wall separating the two alleys of each pair was removed resulting in a triangular-shaped choice area. The 10.5-in. long SB was 3.5-in. wide at the rear door and 2 in. wide in the 8 in. nearest the alleys. Guillotine retrace doors were located 8 in. and 26.5 in. from the SB. The latter defined the goal boxes and the former were used to force S's response to the alternative alley during differential conditioning. Photo beams located at 12 in. intervals down the alleys permitted, in conjunction with a microswitch on the SB door, three successive time measures as S traversed an alley. These measures were converted to ft./sec. and called start, run, and goal speed, respectively.

Three groups of 16 Ss, placed on a 24-hr. feeding cycle on Day 1 of the study, received different amounts of differential conditioning prior to the choice phase. Group 138 received 138 trials from Days 24-49 at the rate of six per day except for Day 24 on which it received one trial, Day 25 on which it received two, and Days 26-28 on which it received three. Group 48 received 48 trials from Days 41-49 also at the rate of six per day except for Days 41-42 on which it received three per day. Group 0 received no differential conditioning prior to the free choice phase, which lasted from Days 50-56, six trials per day for all groups.

The Ss were run in rotation in squads of eight from a single group. Four had 50% of their trials in a black alley rewarded and 100% of their trials in a white alley rewarded, while the other four Ss had the colors reversed. From Day 20 until the beginning of the choice phase all Ss received 24 97-mg Noyes food pellets per day either as reinforcement (six per trial) or incorporated into their daily ration. Similarly Ss not receiving training while others were being conditioned were handled daily to roughly equate this factor.

During differential conditioning number of rewards in the 50% and 100% alleys was equated within a block of six trials resulting in four trials to the 50 and two to the 100% cue. During the choice phase responses to the 100% cue continued to be rewarded as were about half of the responses to the 50% cue.²

Results and Discussion

Differential Conditioning Phase: Mean speeds of Group 138 to the 50% and 100% cues are shown in Fig. 1. Analyses of variance over Blocks 7-11 indicated that asymptotic speeds were faster to the 50% cue than to the 100% cue in starting and running speeds, $F = 30.37$ and 40.81 , $df = 1/14$, $p < .001$, respectively, but slower in goal speeds, $F = 4.52$, $df = 1/14$, $p < .05$. Speeds for Group 48 were similar to the first four blocks of Fig. 1 but they were not significantly different at Block 4.

These data replicate the findings of Amsel et al (1964). Since this second study and Amsel et al used fairly large rewards (six 97 mg and two 500 mg pellets), while the first study and Pavlik et al (1965) used smaller rewards (two and five 45 mg pellets) and failed to obtain differential speeds, the factor of reward magnitude may be critical.

As may be noted from Fig. 1, as well as the data of Group 48, speeds to the 50% cue were generally faster than speeds to the 100% cue rather early in training. This probably results from the procedure of equating rewards but not responses to the two cues, which, according to

Fig. 1. Differential conditioning response speeds of Group 138 to the two cues in the three segments of the response chain. Speeds are averaged into blocks of 12 trials except for Block 11 in which there are 18 trials.

a contiguity theory, would result in the 50% cue developing habit strength at a faster rate than the 100% cue (Ramond, 1954).

Choice Phase. Within each block of six trials speed measures were calculated for Ss which made at least one response to each cue (start speeds are plotted in Fig. 2). Means for Ss over the first three and last four blocks were the units in separate analyses performed for early and late trials, with Groups, Reward schedule (100% vs. 50%) and Color of the cues as factors. These analyses generally supported the following statements: Group 0 displayed little apparent difference between speeds to the 50% and 100% cues in any measure, while, in contrast,

Fig. 2. Response speeds to the selected cue during the 42 choice trials.

Group 138 displayed the differences established during differential conditioning although these differences were small in the run speed measure and tended to attenuate in both the start and run measures. In the goal measure the speeds of Group 138 to the 100% cue remained substantially above those to the 50% cue throughout the 42 choice trials. Group 48 displayed speeds similar to Group 138 except that the initial superiority of the 50% cue in start speed was small.

Percentage choice of the 50% cue was determined for each day of the choice phase. None of the groups displayed any clear preference for either cue over the seven days. The percentages of trials on which the 50% alley was selected during the first three days were 46.2, 51.4, and 52.7 for Groups 0, 48, and 138, respectively. For the last four days the percentages were 42.2, 51.1, and 49.0. Although the differences are in the direction of increased selection of the 50% cue with prior differential conditioning, analyses over all days or only the first three days revealed no significant effect of Groups ($F_s < 1$). There was a strong preference for black regardless of reward probability ($p < .001$).

These results are consistent with the conclusion that the differential conditioning was irrelevant for subsequent cue preference. However, there was a suggestion that position preferences were strengthened by at least the intermediate amount of prior conditioning. According to several stringent criteria of consistency, a preference for an alley in a particular position with respect to the SB (to the left or right) was most prevalent in Group 48 and least in Group 0. Applying the criterion that 37 of the 42 choice trials must display the preference, there were 4, 13, and 6 Ss from Groups 0, 48, 138 meeting this definition, indicating that the occurrence of a rigid position preference was not independent of the groups factor, $\chi^2 = 11.19$; $df = 2$, $p < .01$.

References

- Amsel, A., Mackinnon, J. R., Rashotte, M. E., & Surridge, C. T. Partial reinforcement (acquisition) effects within subjects. *J. exp. Anal. Behav.*, 1964, 7, 135-138.
- Goodrich, K. P. Performance in different segments of an instrumental response chain as a function of reinforcement schedule. *J. exp. Psychol.*, 1959, 57, 57-63.
- Pavlik, W. B., Carlton, P. L., & Hughes, R. A. Partial reinforcement effects in a runway: Between- and within-Ss. *Psychon. Sci.*, 1965, 3, 203-204.
- Ramond, C. K. Performance in selective learning as a function of hunger. *J. exp. Psychol.*, 1954, 48, 265-270.

Notes

1. This investigation was supported in part by Public Health Service Research Grant MH 11029 from the National Institute of Mental Health.
2. Upon request further details are available in an expanded version of this paper.