Magnitude of reward and reinforcement aftereffects

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Rats trained to run a straight alley for either a one or five pellet reward with a double alternation sequence of reinforced and nonreinforced trials ran faster following reinforcement (TFR) than following nonreinforcement (TFN). Speed on TFR did not vary with magnitude of reward, but speed on TFN varied with confinement time in the goal box on nonreinforced trials for a late alley measure. Differences between speeds on TFR and TFN did not vary systematically with stage of training.

In recent years data has accumulated suggesting that reinforcement and nonreinforcement of an instrumental response produces discriminably different aftereffects which affect performance on subsequent trials in such a manner that speeds on trials following reinforcement (TFR) are increased and speeds on trials following nonreinforcement (TFN) are decreased. Studies have shown that these inferred aftereffects can serve as the basis for differential responding (Capaldi & Spivey, 1964), that an aftereffect produced by nonreinforcement can be replaced by an aftereffect produced by reinforcement (Capaldi, Hart, & Stanley, 1963), and that the effectiveness of an aftereffect does not vary with time between trials (Capaldi & Stanley, 1963). Little attention, however, has been directed toward discovering what environmental variables determine the strength or potency of the aftereffect and how the aftereffects develop and change as a function of training. The purposes of the present study were to determine whether or not aftereffects as inferred from differences in performance on TFR and TFN varied systematically with stage of training and magnitude of reward.*

Method

The Ss were 48 experimentally naive male albino rats 100-140 days old at the beginning of the habituation period, obtained from the Holtzman Co.

The apparatus consisted of a straight alley 60 in. long, 4 in. high, and 3-1/2 in. wide covered with clear Plexiglas, painted flat black, and illuminated by a moderately dim diffused light source centered above the alley. A start box 4 in. high, 3-1/2 in. wide, and 9 in. long was separated from the alley with a metal dropping door. A painted metal sliding door was placed 12 in. from the goal end of the alley to prevent retracing. A glass food cup was set into a painted wooden form at the goal end of the alley.

A microswitch was triggered when the start door was dropped, starting a Standard Electric clock. Interruption of a light beam 12 in. from the start door stopped this clock. A second Standard Electric clock was started when a light beam 46 in. from the start door was interrupted. This clock was stopped when a light beam located 2 in. from the end of the alley was interrupted. All times were converted to reciprocals.

Ten days prior to the start of experimental training, individually housed Ss were placed on a restricted diet of 12 g of Purina lab chow per day until their weight had dropped to 85% of their pre-habituation ad lib weight and then fed the daily amount necessary to maintain them at this level.

Twenty-four Ss were randomly assigned to each of two groups. Group 5-25 received five .097 g P. J. Noyes pellets on reinforced trials and was confined to the goal box 25 sec on nonreinforced trials. Group 1-10 received one .097 g pellet on reinforced trials and was confined to the goal box for 10 sec on nonreinforced trials. Half of the animals within each group received their training trials in the order R, NNRRN, NRRNN, RRNNR, RNNRR, NNRRN, NRRNN, RRNNR, RNNRR, where R signifies a reinforced trial and N a nonreinforced trial. The other half of the animals in each group received their trials with the opposite sequence. For each order subgroup, a reinforced trial is followed equally often by another reinforced trial or by a nonreinforced trial. By combining subgroups, when performance on TFR is compared to TFN, the ordinal position of each type of trial is the same.

Each S was given one trial on experimental Day 1 and five trials per day thereafter for eight days, according to one of the sequences described above, for a total of 41 trials. The daily intertrial interval was approximately 15 min.

Results

Figure 1 presents the mean starting speeds on TFR and TFN as a function of training Days 2-9 for Groups

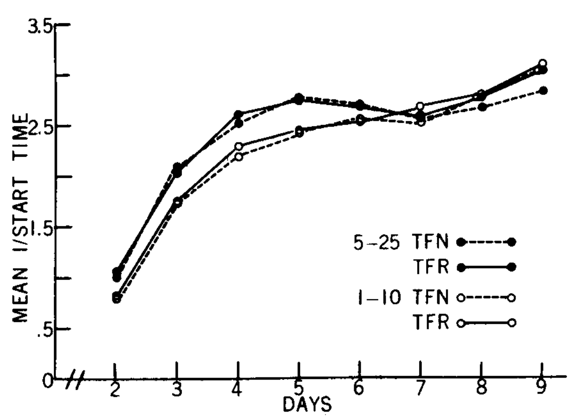

Fig. 1. Mean start speed as a function of days.

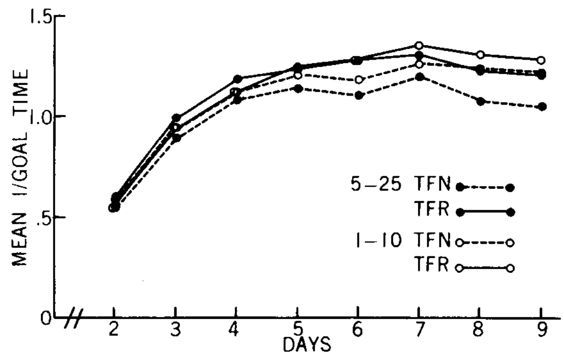

Fig. 2. Mean goal speed as a function of days.

1-10 and 5-25. An analysis of variance of the starting speeds on Days 2-9 with magnitude of reward as a between-effect and type of trial (TFR or TFN) and training days as within-effects indicated that the main effect of type of trial was significant ($F = 4.455$, $df = 1/46$, $p < .05$) with faster speeds on TFR than TFN but that none of the interactions involving type of trial were significant. The main effect of days ($F = 194.778$, $df = 7/322$, $p < .01$) and the interaction of days and magnitude of reward ($F = 3.791$, $df = 7/322$, $p < .01$) were both significant. Inspection of the interaction indicated that Group 5-25 initially performed at a higher level than Group 1-10, but that the curves converged with days.

Figure 2 presents the mean goal speeds on TFR and TFN as a function of training Days 2-9 for Groups 1-10 and 5-25. An analysis of variance similar to that performed on the start speed data indicated that the main effect of type of trial was significant ($F = 7.060$, $df = 1/46$, $p < .05$) with speeds on TFR faster than speeds on TFN.

The interaction of type of trial by magnitude of reward was also significant ($F = 18.569$, $df = 1/46$, $p < .01$). An inspection of the interaction showed that for Group 5-25, speed on TFR was substantially greater than speed on TFN, while for Group 1-10, speed on TFN was very slightly greater than speed on TFR. Further inspection of the interaction showed that TFR speeds were about the same in the two groups with Group 1-10 slightly faster. TFN speeds were considerably slower for Group 5-25 than for Group 1-10. No other interactions involving type of trial were significant.

The only other significant effects were the main effect of days ($F = 70.109$, $df = 7/322$, $p < .01$) and the days by magnitude of reward interaction ($F = 3.328$, $df = 7/322$, $p < .01$). An inspection of the interaction indicated that the curves diverged with days with Group 1-10 speeds faster than Group 5-25 speeds.

Discussion

The present data suggest that insofar as differential speed on TFR and TFN can be attributed to different aftereffects produced by reinforcement and nonreinforcement, these aftereffects are a function of nonreinforced time in the goal box and the portion of the instrumental response chain measured, and are not a function of amount of reward received or stage of training. More extreme values of magnitude of reward, of course, might have produced differential aftereffects and there is some evidence to support this contention. In a recent study, Bloom (1967) reported differences on TFR between groups allowed to eat 60 sec and groups allowed to eat 10 sec. However, even with these values of reward, differences on TFR were significant only for one of six blocks of trials. Comparisons of Bloom's results with the present results are complicated by the fact that Bloom's sequence of R and N trials was such that pattern running could, and did, develop and by the fact that Bloom's response measure was based on total alley running time.

The present data suggest that differences between TFR and TFN do not vary with stage of training. Since speeds were not asymptotic at the end of 40 trials, however, it is possible that prolonged training might produce systematic changes in the differences between TFR and TFN speeds. The present data are not relevant to the frustration theory proposed by Amsel and others (Amsel, 1962; Spence, 1960). With the intertrial interval used in this study, one would not expect speeds on TFN to increase above speeds on TFR as a function of trials due to a frustration produced drive-increment, since the emotion produced by frustrative non-reward is not assumed to persist for long periods of time.

References

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