Differential conditioning with nondifferential reinforcement¹

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The results of two differential instrumental conditioning experiments showed that nondifferentially-reinforced control groups ran faster in the S+ alley, in which discrimination Ss within the same squads received the more favorable incentive, than in the S- alley. This differential responding was tentatively attributed to odors exuded by discrimination Ss.

This paper reports an incidental finding of two experiments primarily concerned with contrast effects in differential instrumental conditioning (cf., Bower, 1961). In differential conditioning the contrast effects refer to the observation that, under certain conditions, running speeds to a given incentive depend upon the nature of the alternative incentive. Comparison of the speeds of a discrimination group running to one of its alternative incentives with those of a (nondiscrimination) control group receiving this same incentive in both alleys provides a method of assessing absolute amounts of contrast. The present report is concerned with the behavior of such control groups.

Method

In Experiment 1, 48 female albino rats received 144 trials in an apparatus comprised of two parallel straight alleys, one black, the other white, and a midgray start box (SB) which could be positioned to adjoin either alley (cf., Ludvigson & Gay, 1966, for details). Opening of a guillotine door separating SB from the running section activated a clock which stopped when S interrupted a photocell beam located 12 in. into the running section, providing a start time measure. Reinforcement delay cycles were initiated by a photocell located 2.5 in. in front of the goal cup in each goal box (GB).

Ss were placed on a 24 hr. food deprivation regimen 24 days prior to the first experimental day (Day 25). On Days 20-24, 10 45-mg Noyes pellets, identical with the subsequent reinforcement pellet, were incorporated into S's daily ration. On Days 23-24, Ss were allowed to explore each alley for 5 min.

Three discrimination groups of 12 Ss each were differentiated according to the incentive (amount in pellets-delay in sec.) received in S+: 1-0, 10-0, and 10-10. All discrimination Ss received one pellet at 10 sec. delay (1-10) in S-. Group 1-10, the nondiscrimination control, received condition 1-10 in both alleys. Ss were run in four squads (two per replication) of 12 Ss each with S+ brightness counterbalanced between squads. Within a squad, Ss were run daily in the order of 1-0, 10-0, 10-10, 1-10, 1-10 etc. until each S within a squad had received six trials, three each to S+ and S-. The sequence of S+ and S- trials was identical to that of Goldstein & Spence (1963).

In Experiment 2, 24 male albino rats received four trials per day for a total of 108 trials in an apparatus similar to that of Experiment 1. The apparatus had a 10 in. long SB, 30 in. long running sections, and 15 in. GBs and was 4 in. high and 3.5 in. wide throughout. Dropping a solenoid-operated door separating SB from the running sections activated a clock which stopped when S crossed a photocell beam located 6 in. into the alley, providing a start time measure. Interruption of a photo-beam located 8 in. in front of the goal cups initiated a reinforcement delay cycle.

Deprivation, prefeeding and habituation procedures were the same as those of Experiment 1 except that Ss were placed on deprivation 14 days prior to the first experimental day.

Two discrimination groups were designated according to the delay (sec.) in GB prior to each reinforcement in S+: Groups 0 and 15. Both groups received 30 sec. delay in S-. Group 30, the nondiscrimination control, received 30 sec. delay in both S+ and S-. Reinforcement always consisted of three 45-mg Noyes pellets. Ss were run in squads of six, two Ss from each group, with S+ brightness counterbalanced between squads. The order of conditions within a squad was initially randomized, but remained fixed throughout the experiment. The sequence of S+ and S- trials was identical with the cycle used by Goldstein & Spence (1963) on the last four trials of the day. In both experiments individual start times were converted to reciprocals (starting speeds). In Experiment 1, only speeds over the last four trials within a day were recorded.

Results

Variance analyses of mean starting speeds over Trials 73-144 (Experiment 1) and 61-108 (Experiment 2) indicated that all discrimination groups displayed significantly ($\alpha = .05$) faster speeds in S+ than in S- except for Group 1-0 in which speeds were nearly identical. Group mean starting speeds for the control Ss of Experiments 1 and 2 as a function of blocks of 12 trials are plotted in Fig. 1. For each control S in any squad, the speeds in the alley in which discrimination Ss in that squad received the greater incentive were designated "S+" speeds and plotted separately from the "S-" speeds obtained in the alley in which discrimination Ss within the squad received the lesser incentive. The S+ and S- functions, then, do not represent differential conditions of reinforcement of Groups 1-10 and 30. Rather, they refer to differential reinforcement conditions for other Ss within the squads. As may be seen in Fig. 1, both Groups 1-10 and 30 ran faster in the S+ than in the S- alley. Variance analyses performed over Blocks 7-12 (Experiment 1)

Fig. 1. Starting speeds to "S+" and "S-" as a function of blocks of 12 trials.

and 6-9 (Experiment 2) yielded significant Discriminandum (S+ vs. S-) effects, $F=9.47$, $df=1/8$, $p < .025$, and $F=6.48$, $df=1/6$, $p < .05$. Neither the counterbalanced Brightness factor nor the Brightness by Discriminandum interaction approached significance in either analysis.

Discussion

The present data suggest that the differential reinforcement conditions for the discrimination groups resulted in discrimination-like behavior for control Ss not differentially reinforced. While it is remotely possible that control Ss did receive more reinforcement in the S+ alleys in Experiment 1 (e.g., from more pellet crumbs remaining in the S+ GB than in the S- GB from the preceding trial), the data of Experiment 2 could not reasonably be interpreted in this fashion since only conditions of delay were varied between alleys for discrimination Ss. Similarly, differential handling of Ss on S+ as opposed to S- trials might account for the data of Experiment 1, but the results of Experiment 1 prompted extraordinary care in avoiding such a possibility in Experiment 2. The most plausible explanation of the present data is that discrimination Ss exuded qualities or quantities of odor on S+ as opposed to S- trials, and that the odor trail left in the S- alley elicited the more competing responses in control Ss.

While the present data suggest specific training procedures for differential conditioning experiments, it is in the context of partial reinforcement that they acquire theoretical significance. If Ss exude differential odors on rewarded (R) as compared with nonrewarded (N) trials, these odors, in addition to eliciting differential competing behavior as suggested by the present data, could function as discriminative stimuli for other Ss. Thus odors exuded by the first S within a squad could, with certain running procedures, be differentially associated with reward and nonreward for the second S, etc.

The patterned running associated with single alternation (SA) schedules of reward and nonreward may be in part attributable to such external odor cues. Particularly in the segment of the response chain immediately preceding the goal would this effect be expected.

Patterned running on SA schedules has been demonstrated in studies in which olfactory cues might serve as discriminative stimuli, e.g., those in which each S is given highly massed training (direct placement from GB to SB), or in which SA Ss are run contiguously and in fixed order from day to day (cf., Capaldi & Stanley, 1963). One SA study in which Ss did not develop patterned running used squads composed of SA and non-SA Ss with running order randomized from day to day (Surridge & Amsel, 1965a). It should be noted that the observation that SA Ss run in random order from day to day within (small) squads pattern with long but not with short GB confinement time on N trials (Capaldi & Lynch, 1966) cannot be interpreted without additional assumptions about odor exuded as a function of confinement time.

The present hypothesis, unlike previous external-cue explanations of SA behavior (cf., Surridge & Amsel, 1965a), is consistent with the behavior of Ss on recursive NNR (Capaldi & Senko, 1962) and double alternation (Bloom & Capaldi, 1961) schedules of reward and nonreward. Finally, according to the present hypothesis Ss run contiguously and in fixed order on the same N-R sequence of irregular partial reinforcement should, as a group, run faster on R as opposed to N trials. Recent data (Surridge & Amsel, 1965b) support this expectation.

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Note

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