A "patterning" effect that seems unrelated to after-effects from reward and nonreward¹

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Abstract

Data are presented to support the contention that cues unwittingly provided by E can yield a discrimination of R from NR trials in partial reinforcement acquisition which could erroneously be regarded as a "patterning" effect.

Introduction

Those of us who subject albinos rats to our experimental procedures sometimes behave as though this animal can only respond differentially to cues we intentionally provide. We seem sometimes to forget that other extraneous cues, not manipulated intentionally and therefore less obvious to us, may still be used by Ss, even those less than human. We have, in our laboratory, become extremely sensitized to the possibility of rats discriminating rewarded (R) from nonrewarded (NR) trials on the basis of cues other than those intentionally provided by, and under the control of, the experimenter, and have in fact previously reported evidence in this direction (Amsel, MacKinnon, Rashotte, & Surridge, 1964).

In a recent publication in this *Journal* (Capaldi & Spivey, 1964), data were presented indicating the occurrence of patterned responding to single alternations (SA) of reward and nonreward at 24-hr. intertrial intervals (ITIs). Subsequently, we presented data from a similar experiment, conducted independently and without knowledge of Capaldi and Spivey's research, which provided no evidence for patterned running under SA conditions after 192 trials, one trial per day (Surridge & Amsel, 1965). Capaldi and Spivey offered an interpretation of their results as being due to "memories" of R and NR trials carried over from one day to the next. Our feeling was that a more plausible explanation of the R-NR discrimination in their experiment might lie in possible bases for direct sensory, particularly olfactory, discrimination provided by the conditions of their experiment.

In a comment on our experiment, Capaldi & Spivey (1965) declared that an "erroneous impression (has been) fostered" by us (p. 132). It was not our intention to foster any impression, but simply to present our data and suggest a reason for the discrepancy between them and other available data. We did not "conclude that massed and spaced trial patterning is contaminated or regulated by visual, olfactory, or auditory cues." We merely cautioned that this was a possibility.

It is entirely possible that what holds under conditions of extreme massing of trials—and most of the work of Capaldi and his associates has been done this way—does not hold with extreme spacing. We would certainly not find it difficult, as S-R psychologists, to accept "pattern-

ing" at a 10 or 20 sec. ITI. But this patterning must be clearly attributable to the sequence of R and N trials *and to nothing else*, and we are not yet convinced that this has been demonstrated. In this connection, the Burt & Wike (1963) study which Capaldi and Spivey cite as evidence (a) that their 24-hr. ITI study should have produced patterning, while our 24-hr. ITI study should not, and (b) of our "unfamiliarity with Burt and Wike or ... failure to understand the result" (p. 132), was conducted with an ITI of 20 sec. and would therefore seem an inappropriate arbiter of a dispute between 24-hr ITI experiments.

The data we report were part of a larger investigation into the temporal properties of frustrative nonreward in a straight runway (Surridge, 1964). This experiment was conducted prior to the Surridge and Amsel experiment and was an important factor in our decision to run a one-trial-a-day study with great control over experimenter cues. The larger experiment involved six groups of rats, three run under 100% reinforcement (CRF) and three run under CRF followed by 50% reinforcement (PRF). E did not intend to provide cues differentiating R from NR trials, and yet PRF Ss showed by their runway performance that they had learned to discriminate R from NR trials, apparently on the basis of uncontrolled incidental cues—at least, no other explanation seems reasonable. Data will be reported for the PRF groups only, since the CRF controls are only indirectly involved.

Method

Thirty male albino rats, approximately 70–80 days old, were supplied by Woodlyn Farms, Guelph, Ontario. One S died during the course of the experiment, leaving 29 from which data were collected.

The apparatus has been described before (Amsel et al, 1964). A straight, 2-1/2 in wide plywood runway contained, in series, a 15-in entry box, a 12-in start box, a 50-in alley, and a 15-in goal box, all separated by guillotine doors. Plexiglas inner walls were lined with black inserts from start box to goal box. Three performance measures were taken by means of a microswitch on the start door and three infra-red photobeams located in the alley.

Ss were placed on a 10-gm-per-day deprivation schedule and were handled and tamed 18 days prior to the start of the experiment. Water was available at all times. On the two days prior to experimental training each S was allowed to explore the runway for a 5-min. period. No food was present on exploration days.

Ss received a total of 96 training trials, four trials per day. Reward consisted of one 500-mg Noyes pellet. The first 32 trials were CRF, following which 50% PRF was introduced for the remaining 64 trials according to the following pattern: R NR R NR, NR R NR R, R NR NR R, NR R NR. On NR trials, Group OP received a 3-sec. flickering light immediately upon beginning to investigate the interior of the food cup (i. e., after the final photobeam had been broken). Group 15P received the CS 15 sec. after, and Group 90P, 90 sec. after initial investigation of the food cup. Thus, the three groups received the CS zero, 15, or 90 sec., respectively following the onset of non-reward.

Fig. 1. Mean median goal time in blocks of 8 trials for CRF and PRF phases (left-hand panel), and mean goal time over the PRF phase for the first trial of the day (right-hand panel).

Results and Discussion

The left-hand panel of Fig. 1 plots mean median goal time in blocks of eight trials over CRF and PRF phases of the experiment. Blocks 5-12 show the PRF phase, in which R and NR trials are plotted separately for each group, four trials per point. The most striking finding was that Ss appeared to be discriminating R from NR trials when there was no ostensible basis for differential responding. Statistical analysis of the PRF phase data performed on speed data (reciprocals of median time adjusted to ft/sec.) indicated significance for (a) the Trials effect, $F(7, 360) = 23.20$, $p < .01$; (b) the Type by Trials interaction, $F(7, 360) = 4.65$, $p < .01$, and (c) the Delay by Trials interaction, $F(14, 360) = 2.80$, $p < .01$. The significance of the Type by Trial interaction confirmed the suggestion that Ss were in fact discriminating R from NR trials.

Since the discrimination might have occurred on the basis of the aftereffects of R and NR trials, we plotted (see the right-hand panel of Fig. 1) data from the first trial of each PRF day, in mean goal times for R and NR trials. The form of the curves is almost identical to that of the curves when data are taken from all four trials of the day. Since the last trial of a day and first trial of the next day are equally often alike and unlike, the possibility that discrimination occurred on the basis of aftereffects from the preceding trial is ruled out. The discrimination could not have been based on alley conditions since these were undifferentiated on R and NR trials (the CS was not presented until after S had interrupted the final photobeam). Moreover, discrimination based on visual or olfactory cues could not have occurred since (a) S could not see the food pellet until after the final photobeam was broken, and (b) the floor under the runway (not visible to S) was covered with food crumbs.

A more feasible explanation seems to lie in the possibility of uncontrolled differential extraneous cues corresponding to R and NR trials. One possibility is that the discrimination occurred on the basis of different ITIs on R and NR trials. On R trials, Ss were removed from the goal box immediately after eating (30-45 sec.); on NR trials Ss were detained in

the goal box for 90 sec. The ITI following R trials was approximately 15 min., while the following NR trials was approximately 27 min. However, this argument is weakened by the first-trial data, showing discrimination with a constant ITI of 24 hr. A stronger possibility is discrimination based on E's activity before R and NR trials: after R trials, it was necessary to brush the uneaten crumbs of food from the goal box; after NR trials the goal box was never brushed out. The possible effects of such differential auditory stimulation might have been augmented by the order in which Ss were placed in the carrying cage and run each day, which was the same throughout the experiment (not our usual procedure). There were five squads of Ss, each containing two Ss from each experiment group (including the three CRF groups). The order of placement in the carrying cage was as follows: 6 CRF Ss, followed by two of each of Groups OP, 15P, 90P (two animals from each group side by side). Thus the 6 CRF Ss were always run first on any trial, and the 6 PRF Ss last. The OP Ss were always run immediately after the continuous ones, and since E's activity was never differential after a continuous S, it seems less likely that Group OP would discriminate as much as the other two groups. As E proceeded to the 15P and 90P Ss, however, the effect of differential E cues would become more pronounced (i.e., the fourth S would have heard the differential sounds three times, the fifth S, four times, and so on). The trends in the data bear out these conclusions, for Group OP does not discriminate until relatively late in training, while Groups 15P and 90P discriminate quite early.

Our purpose in presenting these data is simply to support our contention that experimenter cues, inadvertently provided, may produce the appearance of patterning. We do not thereby conclude that this same kind of error has necessarily occurred in the experiments of other investigators; but we are greatly sensitized to this possibility and feel bound to point it out.

References

- Amsel, A., MacKinnon, J. R., Rashotte, M. E., & Surridge, C. T. Partial reinforcement (acquisition) effects within subjects. *J. exp. Anal. Behav.*, 1964, 7, No. 2, 135-138.
- Burt, D. H., & Wike, E. L. Effects of alternating partial reinforcement and alternating delay of reinforcement on a runway response. *Psychol. Rep.*, 1963, 13, 439-442.
- Capaldi, E. J., & Spivey, J. E. Stimulus consequences of reinforcement and nonreinforcement: Stimulus traces or memory. *Psychon. Sci.*, 1964, 1, 403-404.
- Capaldi, E. J., & Spivey, J. E. Comment. *Psychon. Sci.*, 1965, 3, 110.
- Surridge, C. T. Experimental studies of temporal factors in the conditioning of frustration. Unpublished Master's thesis, University of Toronto, 1964.
- Surridge, C. T., & Amsel, A. Performance under a single alternation schedule of reinforcement at 24-hour intertrial intervals. *Psychon. Sci.*, 1965, 3, 131-132.

Note

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