

DISCUSSION

Results of this study clearly indicate that a prior history of response contingent food-CR pairings is not a necessary condition for establishing CR maintained responding in the Zimmerman and Hanford one-key procedure. It further demonstrates that response rates are comparable to previously reported studies and respond similarly to parametric manipulations. The two control conditions point out that the strength of the response was directly related to the specific stimuli paired with food since responding dropped dramatically when a novel stimulus was introduced and during CR extinction. The dramatic increase in response rates for two of the subjects following CR extinction is hard to explain. It possibly could be a result of the nature of the CR extinction condition, namely, allowing CR-food pairings to continue thus strengthening the reinforcing properties of the CR while not allowing for the concomitant reduction in CR strength because the CR was not presented without the food.

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Negative S-contrast with minimal response requirements in S+*

STEPHEN WERK† and JAMES H. McHOSE
Southern Illinois University at Carbondale, Carbondale, Illinois 62901

Forty rats received runway and placement reward training in an experiment which factorialized, between subjects, the amount of runway and placement reward received on each trial. Speeds to the small runway reward were depressed by large reward placements and by a discrepancy between placement and runway reward amounts. The results suggest that the S-contrast effect observed in differential conditioning occurs even when S+ response requirements are minimal and quite different from those in S-.

Several differential instrumental conditioning studies have demonstrated that locomotor speeds to one cue (S1) are a function of the relationship between the reward magnitude contingent upon S1 running and the reward magnitude contingent upon running to the other

cue (S2) (cf. McHose, 1970). More specifically the discrepancy between an S+ reward magnitude and an S- reward magnitude typically produces a depression of both S+ and S- running speeds.

The purpose of the present study was to determine whether this discrepancy between S+ and S- reward magnitudes produces a depression of S- speeds in the absence of an S+ instrumental running response. Maxwell, Meyer, Calef, and McHewitt (1969) and Calef (1972) employed standard runway S- trials, while the S+ trials consisted of placing the subjects directly at the

*Based in part on a thesis submitted by the senior author to the Southern Illinois University Graduate School in partial fulfillment of the requirements for the M.A. degree. Reprint requests should be sent to James H. McHose, Department of Psychology, Southern Illinois University at Carbondale, Carbondale, Illinois 62901.

†Now at Laurentian University, Sudbury, Ontario, Canada.

locus of reward. Neither study found evidence for S- depression. In a similar study, however, Harris, Collerain, Wolf, and Ludvigson (1970) did obtain depressed S- speeds. Following the reasoning of Harris et al (1970), it is possible that an unmeasured depression of S- speeds may have in fact occurred in the Maxwell et al (1969) and Calef (1972) studies. Ludvigson and Gay (1967) have shown that the S- depression produced by contrasting reward magnitudes is most prominent immediately following the presentation of the cues distinguishing an S+ from an S- trial. Since Maxwell et al (1969) and Calef (1972) placed the animals in the startbox only on S- trials, this placement itself would constitute such a cue and possibly would enable the contrast effect to dissipate in the startbox before the animal was given access to the S- alley. To eliminate this premature cueing, Harris et al (1970) began each trial in the startbox. On S- trials the subjects were given access to the S- alley. On S+ trials the subjects were removed from the startbox and given reward without running. Under these conditions a large placement reward depressed speeds to a small runway reward.

While it is apparent from the Harris et al (1970) data that a depression of S- speeds can occur in the absence of an S+ running response, it is possible that this depression was produced by variables other than the discrepancy between S1 and S2 reward magnitudes. Harris et al (1970) raised the possibility that their S- depression was due to a competing "prepare or wait-to-be-picked-up" response which might result from being removed from the startbox and rewarded on some trials. Since the large placement reward condition received greater reward for this competing response than would the small placement reward group, the lower S- speeds of the former group would be consistent with the competing response notion. This competing response hypothesis implies a main effect of S2 (placement) reward magnitude such that the greater the S2 reward magnitude the stronger the competing response, and therefore the greater the S1 response depression.

The present study factorially manipulated placement (S2) and runway (S1) reward magnitude in order to isolate the contributions of the S2 (placement) reward magnitude and the reward magnitude discrepancy variables to the S- depression obtained in the absence of S+ running.

METHOD

Subjects

The subjects were 40 naive male albino rats 80 days old when the deprivation schedule was instituted, obtained from the Holtzman Company, Madison, Wisconsin.

Apparatus

The apparatus consisted of a 10-in. start section, a 30-in. alley section, and a 12-in. goal section. The interior height and width of all sections were 4 in. and 3 1/2 in., respectively. All sections were painted flat black. A clear Plexiglas guillotine-type retrace

door separated the goal and runway sections while an opaque solenoid-operated door separated the start and runway sections. A Pamotor Model 1000A fan mounted on the rear of the goalbox extracted air from the alley through 1/8-in. holes. Photocell-clock circuitry provided for the measurement of times over three successive lengths beginning at the start door. Timing began with the dropping of the start door. In addition, a 28-5/8 x 20-5/8 in. metal placement table was employed. The table surface, bordered by a 1-3/8-in. high lip, was covered with newspaper. A circular glass feeding cup 2-1/4 in. in diam was located at the center of the placement table surface.

Procedure

There were nine days of habituation preceding the first training day (Day 10). Beginning on Day 1 and continuing throughout the experiment the subjects were placed on a food deprivation schedule consisting of 10-15 g of Purina Lab Chow administered once daily. Water was available at all times. On Days 5-7, all subjects were handled in groups of five and six. On Days 8 and 9 each subject was fed 10 45-mg Noyes pellets on a neutral surface (a rubber-topped rolling tray), adapted to carrying cages, startbox, alley, and placement table (with newspaper but without glass cup or pellets).

Forty subjects were randomly distributed equally among four groups. With the exception of Days 10 and 11 (with two trials each) four trials were administered daily, two runway and two placement trials. All trials began in the startbox of the runway. After 3-sec orientation toward the startbox door, either the Plexiglas startbox cover was opened and the subject removed for a placement, or the startbox door was opened for a runway trial. Each group received its four daily trials according to the following repeating cycle of placement (P) and runway (R) trials, PRPR, RRPP, RPPR, PPRR, RPRP, PRRP, until a total of 96 trials were completed. The groups labeled according to the number of 45-mg Noyes pellets received on placement and runway trials, respectively, were 12-1, 1-1, 12-12, 1-12. The subjects were run in squads of 10 including two subjects from each experimental condition (and two subjects from a group not relevant to the present report). The intertrial interval was approximately 12 min. Each subject was removed from the goalbox or placement table immediately following food consumption. All subjects were fed after the last squad was run.

RESULTS

Group mean start, run, and goal speeds are plotted as a function of blocks of four trials in Fig. 1. As may be seen, over the later stages of training, the speeds of the groups with the higher placement reward magnitudes (Groups 12-1 and 12-12 combined) were inferior to those of the low reward magnitude placement groups 1-12 and 11 combined) in all three response measures. There was also a tendency in the start and run measures toward faster speeds for the high runway reward magnitude groups (1-12 and 12-12) in combination relative to those of the low runway reward magnitude groups. Finally, in the start measure, the groups receiving discrepant placement and runway reward magnitudes (1-12 and 12-1) exhibited, in combination, inferior speeds relative to those of the combined nondiscrepant groups (1-1 and 12-12).

The results of several analyses of variance of the data over Blocks 7-12, containing placement and runway reward magnitude as factors, support all of the above

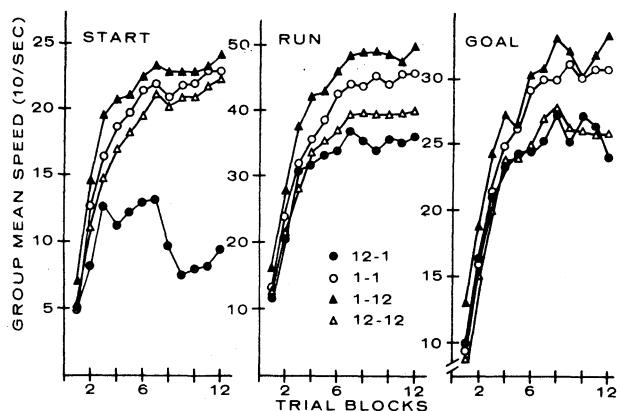


Fig. 1. Group mean start, run, and goal speeds for the various groups as a function of blocks of four runway trials.

conclusions, yielding significant placement magnitude effects in all three segments of the alley ($F = 49.75$, 27.15 , and 15.71 , $p < .001$ in the start, run, and goal sections respectively). The runway magnitude effect was significant in the start and run sections ($F = 36.88$, 5.10 , $p < .001$, $.05$) but not in the goal section. The analyses further yielded a significant Placement by Runway Magnitude interaction in the start segment only ($F = 26.14$, $p < .001$) indicating that the discrepant conditions were slower than the nondiscrepant ones.

With respect to the pair comparisons of interest, Figure 1 indicates slower speeds for Group 12-1 than for Group 1-1 in each response measure. Pair comparisons (Tukey HSD) revealed that these differences were significant ($\alpha = .05$ in all pair comparisons) in the start and run sections, but not in the goal section. A subsequent pair comparison (t test) revealed a significant difference in the goal section as well.

As may also be seen in Fig. 1, Group 1-12 speeds were superior to those of the 12-12 group in each response measure. Pair comparisons (Tukey HSD) revealed these differences to be significant in the run and goal measures only.

DISCUSSION

The present data replicate the Harris et al (1970) finding that subjects receiving large reward placements run more slowly to a small runway reward than do subjects receiving small reward placements. This S- depression was manifested throughout the later stages of training in the slower speeds of Group 12-1 relative to those of Group 1-1.

Of primary interest in the present experiment was the question of whether the observed S- depression should be attributed to the effect of a contrast between S2 (placement) and S1 (runway) rewards or to a debilitating effect of S2 reward on S1 performance. The present data, obtained from the requisite factorial manipulation of S1 and S2 reward magnitude, indicate that the S- depression observed in the run and goal measures was produced solely by the placement (S2) reward effect. Thus large placement (S2) magnitude subjects ran more slowly (to S1) than small placement magnitude subjects. In the start data, however, the S- depression is most reasonably

attributed to the joint effects of the placement and discrepancy (contrast) variables, with small placement magnitude and nondiscrepant magnitude subjects running faster than large placement and discrepancy subjects. Thus in the early segment of the response chain, a discrepancy or contrast between S1 and S2 rewards does depress S1 performance, even when no running response is required on S2 trials. In other words, an S+ running response is not a necessary condition for the production of negative S- contrast. In fact the present data, in conjunction with those of previous studies, suggest that several aspects of S1 performance are independent of the nature of the S2 instrumental response. Thus the present data concur with those of typical contrast studies (cf. Black, 1968; and McHose, 1970) involving running responses on both S+ and S- trials in revealing not only a contrast-produced S- depression, but also in showing that this contrast effect was most pronounced proximal to the point at which the cues differentiating S+ and S- trials were first presented (Ludvigson & Gay, 1967).

While the present reward discrepancy effect does correspond to the findings obtained in previous studies, the observed placement magnitude effect (in the form of an effect of S2 reward on S1 performance) does not normally appear in studies employing the running response on both S1 and S2 trials. The presence of the placement effect in this study and its absence in typical contrast studies supports the competing response analysis presented earlier. In the usual contrast study, the response which is sufficient to obtain reward on S1 trials is similarly sufficient to obtain reward on S2 trials. In the present study, this is not the case. Forward locomotion in the startbox obtained reward on runway trials but did not suffice on placement trials. In other words, the response sufficient to obtain reward on S1 and S2 trials are compatible (or in fact identical) in typical studies but incompatible, or competing, in the present investigation.

In light of the effectiveness of the placement variable in the present investigation, the seeming ineffectiveness of this variable in the Maxwell et al (1969) and Calef (1972) studies warrants comment. The present view is that the premature cueing in those stages accounts not only for the lack of contrast induced depression as explained by Harris et al (1970) but for the lack of placement reward induced depression as well. In the present study, the effects of the placement variable appeared to be most pronounced temporally proximal to the initiation of the cues differentiating a placement from a runway trial. The differentiating cues in the Maxwell et al (1969) and Calef (1972) studies were presented some time prior to the onset of the measured response, and thus would enable the effect of the placement variable to dissipate before the start door was lowered.

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