

## REWARD MAGNITUDE AND LEARNING IN A SINGLE-PRESENTATION DISCRIMINATION

G. H. BOWER<sup>1</sup> AND M. A. TRAPOLD<sup>2</sup>

*Yale University*

The purpose of this experiment was to study the effect of amount of reward on performance in a single-presentation discrimination. Rats were reinforced for running down a gray alley to a black goalbox (S<sup>+</sup>) but were not reinforced in a white goalbox (S<sup>-</sup>). Half the Ss received a large reward, and half received a small reward. Generalizing from single-runway studies (Crespi, 1943), one would expect response speed in S<sup>+</sup> to be faster with the larger reward. However, there is no evidence on whether magnitude differences in S<sup>+</sup> influence terminal performance in S<sup>-</sup>, and one interest of this study was to answer this question.

Spence (1956) has proposed the hypothesis that magnitude of reward affects a motivational factor (incentive or  $r_{\theta}$ ) that is learned and must be elicited by discriminative stimuli to facilitate performance. According to this hypothesis, differences in amount of reward in S<sup>+</sup> should not influence terminal performance in the nonreinforced stimulus, S<sup>-</sup>. This prediction contrasts with a comparable prediction for variations in another motivational variable, drive (i.e., hours of deprivation), which is independent of a conditioning history; increases in hours of deprivation would be expected to increase terminal performance in S<sup>-</sup>, but two experiments reported by Spence (1958) give conflicting evidence on this point.

A second question of interest was whether performance in S<sup>+</sup> would improve if S<sup>-</sup> trials were eliminated after extensive discrimination training. It is known, at least for classical defense conditioning (Gynther, 1957), that performance of Ss given simple conditioning is superior to that of Ss given discrimination training. The present study, using a locomotor response, compared these two conditions within the same Ss. Following discrimination training, Ss were shifted to all S<sup>+</sup> trials, and

the question of interest was whether or not performance increments would occur following this shift.

### METHOD

#### *Subjects*

Twenty male albino rats from the Holzman Co. were used as Ss.<sup>3</sup> They were 90 days old at the beginning of the experiment and were maintained in individual living cages with free access to water.

#### *Apparatus*

The apparatus was an L shaped alley similar in construction to that of Freides (1957). The long alley of the L was 4 in. wide and 47 in. long, the first 7 in. comprising the startbox. A 5-in. by 4-in. hole was cut in the right wall at the far end of the long arm. One of two goalboxes could be attached against this opening.

Except for color and floor texture, the goalboxes were of identical construction; 4 in. wide and 24 in. long with wire-mesh tops. Food could be placed in a ½-in. depression in a block of wood at the end of the goalbox. One goalbox was painted black with a smooth wood floor; the other was white with a sandpaper floor. The first 3 in. of the white goalbox were painted black. The startbox and long alley were medium gray. The startbox and goalboxes were equipped with guillotine doors. A Standard electric clock started when the startdoor was raised and stopped when S stepped on a panel which comprised the last 7 in. of the floor of the long alley. Stepping on this panel started a second clock, which stopped when S stepped on a panel comprising the last 6 in. of the goalbox floor. Both time measures were read to the nearest .01-sec. and were transformed to speed scores (1/time). These measures will be referred to as "alley speed" and "goal speed."

#### *Procedure*

Subjects were randomly assigned to two groups and put on a 24-hr. feeding cycle. They were fed 14 gm of Purina Lab Checkers at the same time each day for seven days. Training was begun on the eighth day. The procedure for a trial was to remove S to a detention box for 1 min., place it in the startbox, and open the door when S oriented toward the startdoor. If the trial was reinforced, S was removed after eating; if non-reinforced, S was removed after depressing the panel in the goalbox or after 1 min. If more than one trial

<sup>1</sup> Now at Stanford University. This experiment was performed during this author's tenure on a predoctoral fellowship provided by the National Institutes of Mental Health.

<sup>2</sup> Now at the State University of Iowa.

<sup>3</sup> Four other Ss started in the experiment but were discarded early in training for failure to respond. Three of these Ss were from the small reward group, and one was from the large reward group.

per day was given, all *Ss* were run in rotation through each trial, the intertrial interval being about 20 min. The *Ss* received the 14-gm. daily ration, corrected for the amount of food received in the alley, about 10 min. after the last trial of the day.

In discrimination training the black goalbox was used as the  $S^+$  goalbox. The *Ss* in the large-reward group received eight P. J. Noyes food pellets (.045 gm. each) on each  $S^+$  trial and the small-reward *Ss* received one pellet. The first 10 trials were to  $S^+$ . These were given at 1 trial per day for the first 4 days and 2 per day for 3 days. Beginning with Trial 11 the *Ss* received 4 trials a day, 2 to  $S^+$  and 2 to  $S^-$ , the distribution of trials within a day being determined by a set of counter-balanced sequences. Discrimination training continued for 19 days (76 trials), at which time performance in  $S^+$  and  $S^-$  appeared to have leveled off. At this point  $S^-$  trials were eliminated, and training continued at 4  $S^+$  trials a day for 17 more days (68 trials).

### RESULTS

The results are shown in Figures 1 and 2 for group mean alley and goal speeds, respectively. Alley speeds on  $S^+$  and  $S^-$  trials are pooled in Figure 1 since they were the same. This was expected since the L maze was so constructed as to preclude reception of goalbox cues while *S* was in the alley.

During the first 10 trials only  $S^+$  trials were given; when  $S^-$  trials were introduced, a significant drop in mean alley speeds occurred the next day ( $t = 6.48$  and 4.60 for 8 and 10  $df$ ,  $p < .01$  in both cases), but this drop is obscured in Figure 1, where speeds are plotted in sliding blocks of five days.

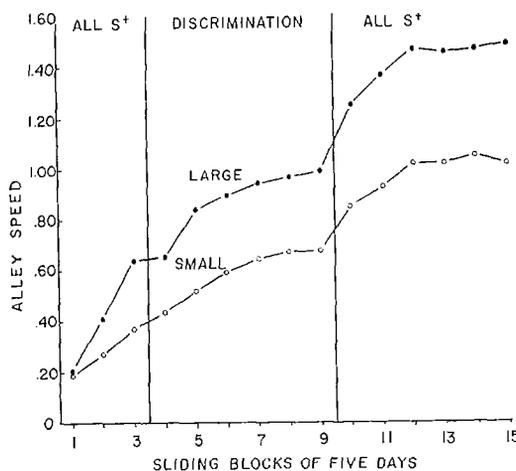


FIG. 1. Group mean alley speed in sliding blocks of five days. Alley speeds for  $S^+$  and  $S^-$  trials were pooled for this graph since the measures were practically identical.

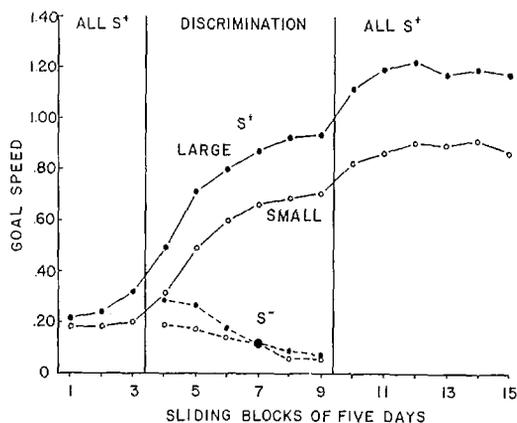


FIG. 2. Group mean goal speeds in sliding blocks of five days. The top two curves are for  $S^+$  trials, the bottom two for  $S^-$  trials. Within each pair the upper curve is that for the large-reward group.

During the early part of discrimination training (first eight days after  $S^-$  trials began) the large-reward group ran faster than the small-reward group in the alley and  $S^+$  goalbox. The group means of individual *Ss*' means differed by a  $t$  test at the 5% level for both alley and  $S^+$  goal speed. The large-reward group was slightly faster in  $S^-$  during this early period, but this difference was not significant ( $t = 1.16$ ;  $df = 18$ ). Within these first eight days significant differences developed between performance in  $S^+$  and  $S^-$  ( $p < .01$  in both groups).

During the latter part of discrimination training (last eight days) the large-reward group responded faster than the small-reward group in the  $S^+$  goalbox ( $p < .02$ ) and in the alley ( $p < .01$ ). However, there was no reliable difference in their performance in  $S^-$ .

As can be seen in the right sides of Figure 1 and 2, the shift to 100%  $S^+$  trials was followed by an increase in alley and  $S^+$  goal speeds. The mean increments in speeds from the last four days of discrimination training to the last four days on the 100%  $S^+$  schedule were tested by  $t$  and found to be significant at the .01 level for both groups and both measures (alley and goal speed).

### DISCUSSION

The results show that in a single-presentation discrimination, performance in  $S^+$  is an increasing function of the amount of reward.

This result was expected on the basis of single-runway studies such as that of Crespi. With the present experimental conditions, terminal performance in  $S^-$  was not related to amount of reward in  $S^+$ . These data are consistent with the hypothesis that incentive motivation is conditioned to discriminative stimuli and must be elicited to facilitate performance. If  $S^+$  and  $S^-$  are highly dissimilar (black and white), then the incentive conditioned to  $S^+$  should not generalize appreciably to  $S^-$ . Accordingly, with such stimulus differences in  $S^+$  and  $S^-$ , terminal performance in  $S^-$  should not be affected by amount of reward in  $S^+$ .

The increase in speed following the shift to 100%  $S^+$  trials was very striking. Observation of the Ss indicated that the speed increments were due to the elimination of "slowing down" near that point in the L maze where the discriminative stimuli were presented. Such "slowing down" near the information point was quite evident during discrimination training, but it was not measured directly. An hypothesis suggested by this observation is that Ss learn to make observing responses at that point in an instrumental response chain where discriminative stimuli are presented. If it is assumed that performance of the observing responses competes with running, then we may account for the result that Ss slow down as they near that point in the response chain where discriminative stimuli are presented. This hypothesis accounts in part for the increase in  $S^+$  speeds following the shift to 100%  $S^+$  trials, since the observing responses should extinguish under a 100%  $S^+$  schedule.

## SUMMARY

Two groups of rats were run in an L alley to food reward. They were reinforced if the goal arm of the L alley was black ( $S^+$ ) but not if it was white ( $S^-$ ). One group received a large reward and the other group received a small reward. Terminal speed in  $S^+$  was an increasing function of amount of reward, whereas terminal speed in  $S^-$  was not affected by reward magnitude in  $S^+$ . This result was interpreted in terms of a conditioned incentive hypothesis.

Following discrimination training,  $S^-$  trials were eliminated and only  $S^+$  trials given. This change produced an increase in response speeds. This result was interpreted in terms of the learning (during discrimination training) and extinction (during the 100%  $S^+$  schedule) of observing responses at that point in the response chain where discriminative stimuli are presented.

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