The influence of cue position and pretraining on successive discrimination learning in the rat¹

LARRY M. RASKIN
McGILL UNIVERSITY

Abstract

Two degrees of cue-reward separation and two degrees of rewarded pretraining were used in studying the learning of a successive (go-no go) discrimination task by rats. Only Ss receiving the cue nearer the reward learned. Pretraining was found to be inconsequential. An explanation in terms of a gradient of stimulus sampling or attention appears tenable.

Problem

Several investigators have studied the effects upon discrimination learning of distances separating cue-position, locus of response, and reward location (e.g., Jeffery & Cohen, 1964; McClearn & Harlow, 1954; Murphy & Miller, 1955, 1958; Wunderlich & Dorff, 1965). Taken as a whole, these studies, all of which employed primates as Ss, have led to the conclusion that cue-response separation, rather than cue-reward separation, is the factor of primary importance in discrimination learning. The present study was concerned with the effects of cue-reward separation on discrimination learning in the rat.

All previous investigators used the simultaneous method of cue presentation. In the present study training was carried out by the successive method of cue presentation (go-no go paradigm). This paradigm calls for the presentation of only one discrimination cue on each trial. The present study was undertaken to ascertain if previous findings and interpretations were applicable to successive discrimination learning in the rat.

Method

Ss were 48 naive male hooded rats, about 90 days old (200 gm) at the start of the experiment. They were maintained on a 23-hr. water deprivation schedule. Ss were trained and tested in a 6-in wide and 14-in high grey runway. It consisted of a start box, a running area, and a goal box, 12 in, 18 in, and 14 in, in length, respectively, which were separated by two doorways. The doorways were blocked by hanging cards which could be used as discrimination cues. In preliminary training, Ss learned to push the cards and walk under them for brief access to a water tube in the goal box.

Ss were divided into two groups following preliminary training. A "far-cue" group (N=24) received the positive or negative cue 1/2 in outside a guillotine starting gate, 31-1/2 in from the reward. A "near-cue" group (N=24) received the positive or negative cue at the entrance to the goal box, 12 in from the reward. Twelve Ss in each group were given 60 rewarded trials, 10 per day for six days, with only the positive cue present. The

remaining 12 Ss in each group were not given this pretraining. Nonpretrained Ss began the black-white discrimination task on the day following preliminary training. For all groups a black card served as the positive cue; a white card served as the negative cue. So that all Ss would push through a card-doorway at each cue position, a grey card was used at the irrelevant cue position for each group (e.g., the far-cue group pushed through a grey card at the near cue position). Discrimination learning consisted of 10 trials per day, six days a week, for five weeks, a total of 300 trials. A 50% random schedule of cue-reward presentation was used. On a positive trial Ss were permitted to drink water in the goal box for 15 sec. On a negative trial no water was present in the goal box, and Ss were retained there for 15 sec. The intertrial interval was about 3 min. Learning consisted in running when the positive cue was presented and withholding this response when the negative cue was presented. Starting and running times were measured by appropriately placed photo-cells.

Results

Median starting and running times were determined for each S for the five positive and five negative trials each day. Difference scores were found by subtracting median times on positive trials from median times on negative trials. Mean group starting and running difference scores were then ascertained for blocks of three days (30 trials). Twenty-one of the 24 Ss in the near-cue group showed evidence of successful discrimination learning, as judged by their running difference scores. Figure 1 shows statistically significant Trials x Cue-Position interaction effect for running times ($F=12.92$, $df=9/396$, $p<.001$). Ss in the far-cue group were expected to show large starting time difference scores as an indication of learning; only one of the 24 Ss in this group learned. Neither the pretraining effect nor any interaction involving pretraining reached statistical significance, although, as Fig. 2 shows, there was a tendency for nonpretrained Ss in the near-cue group to show learning earlier than pretrained Ss.

Discussion

These results indicate that spatial proximity between cue and reward is an important variable in successive discrimination learning in the rat. This finding appears to be at variance with the results reported by investigators using simultaneous methods of cue presentation with children and monkeys, where cue-response separation seems to be the factor of primary importance.

Fig. 1. Trials $\times$ Cue-Position interaction in "near" and "far" groups for running-time difference scores.

As an explanation of findings on the effects of cue-response separation on discrimination learning, Schuck (1960) and Stollnitz (1965, in press) have suggested the existence of a gradient of visual sampling (or attention) that decreases with increasing separation. Before a corresponding cue-reward gradient is invoked to deal with the present results, it must be shown that animals in the far-cue group did have the opportunity to observe the cue. Since, in the case of this group the cue was placed only 1/2 in outside the opaque guillotine starting gate, it may be argued that, as soon as the gate was raised, the animals rushed out ("through" the cue card) so quickly that they had little time to observe the cue. A subsidiary far-cue group ($N=12$), was, therefore, tested. Here a transparent guillotine gate was used through which inspection of the cue was possible during a 5-sec. waiting period before the gate was raised. None of these 12 animals learned the discrimination in 300 trials even though they had a clear opportunity to observe the cues. Thus the sampling or attention hypothesis seems tenable for the interpretation of successive discrimination learning in rats.

The lack of an effect attributable to rewarded pretraining does not agree with predictions made by Amsel (1962) in his frustrative nonreward theory of discrimination learning. Amsel predicts that Ss given continuous prediscrimination rewards with the subsequent positive cue would learn faster than Ss not given such pretraining. In this study, pretrained Ss appeared to show a retardation, rather than a facilitation, in learning. If, like exploratory responses,

Fig. 2. Average median running-time difference scores for pre-trained and nonpretrained Ss in the "near" groups.

sampling or attending responses can be assumed to occur more vigorously early in training, and to decline after continued experience in the learning situation, pretraining without differential cues would be expected to retard subsequent discrimination learning.

References

- Amsel, A. Frustrative nonreward in partial reinforcement and discrimination learning: some recent history and a theoretical extension. *Psychol. Rev.*, 1962, 69, 306-328.
- Jeffrey, W. E., & Cohen, Leslie B. Effects of spatial separation of stimulus, response and reinforcement on selective learning in children. *J. exp. Psychol.*, 1964, 67, 577-580.
- McClearn, G. E., & Harlow, H. F. The effect of spatial contiguity on discrimination learning by monkeys. *J. comp. physiol. Psychol.*, 1961, 54, 175-177.
- Murphy, J. V., & Miller, R. E. The effect of spatial contiguity of cue and reward in the object-quality learning of rhesus monkeys. *J. comp. physiol. Psychol.*, 1955, 48, 221-224.
- Murphy, J. V., & Miller, R. E. Effect of spatial relationship between cue, reward, and response in simple discrimination learning. *J. exp. Psychol.*, 1958, 56, 26-31.
- Schuck, J. R. Pattern discrimination and visual sampling by the monkey. *J. comp. physiol. Psychol.*, 1960, 53, 251-255.
- Stollnitz, F. Spatial variables, observing responses, and discrimination learning sets. *Psychol. Rev.*, 1965, 72, in press.
- Wunderlich, R. A., & Dorff, J. E. Contiguity relationships of stimulus, response, and reward as determinants of discrimination difficulty. *J. comp. physiol. Psychol.*, 1965, 59, 147-149.

Notes

1. This work was supported by Grant No. APT-74 from the National Research Council of Canada and Grant No. MH-03238 from the United States Public Health Service to Dr. Dalbir Bindra. The research was part of a thesis submitted to the Graduate Faculty of McGill University in partial fulfillment of the requirements for the M. A. degree, 1964.
2. This report was presented at the Eastern Psychological Association meeting, Atlantic City, N. J., April, 1965.