Competing responses in a differential magnitude of reward discrimination¹

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The incidence of alley retracing was recorded in a differential reward magnitude discrimination. Five groups of rats received 500 mg reward to one stimulus (S_1) and either 500, 250, 90, 37, or 0 mg reward to the other (S_2). Following training, extinction trials were run to S_1 only. The retracing patterns observed were discussed in the context of frustration theory.

Several experiments involving differential reward magnitude discrimination have shown that performance to one stimulus is not independent of the reward magnitude associated with the other stimulus in the discrimination (e.g., Bower, 1961; Davenport, 1962; Ludvigson & Gay, 1967; MacKinnon, 1967). An interpretation of how the interactive effects of the two incentives determine performance in such a discrimination is provided by an extension of frustrative nonreward theory (Amsel, 1958). The suggestion is that frustrative responses are generated to the small reward stimulus through the generalization of anticipatory goal reactions (r_G s) from the large reward discriminandum. The development of anticipatory small-reward-produced frustration to the small reward stimulus should result in the elicitation of competing responses which act to retard performance to that stimulus. Furthermore, it has been shown (MacKinnon, 1967) that performance to the large reward stimulus is inversely related to the intensity of the small-reward-produced frustration.

The present data, collected in conjunction with standard runway performance measures (MacKinnon, 1967), trace the development of an easily recorded competing behavior (i.e., the alley retrace) in a discrimination based on differential magnitudes of reward, and provide additional support for a theoretical interpretation based on small-reward-produced frustration.

METHOD

The apparatus, described in detail elsewhere (MacKinnon, 1967), consisted of two parallel alleys, one painted flat black and the other flat white. A common prestart (PSB) and start box (SB) unit, painted flat gray, was separated from the alley proper by a Plexiglas door. Performance measures (start, running, and goal times) were recorded over successive 1-ft segments of the alley. Inside dimensions of each alley were 3-3/4 in. x 3 in. The final 13 in. of the runway, when enclosed by a metal guillotine door, served as the goal box (GB).

Sixty male albino rats, approximately 120 days old, were assigned randomly to five groups, designated as Groups 500:500, 500:250, 500:90, 500:37, and 500:0, and were run six trials per day, with three of the daily trials to one alley brightness (S_1), and three to the other (S_2). The numerals of the group labels indicate the S_1 : S_2 reward magnitudes (in mg). Color conditions were counterbalanced within groups, and orders of presentation of S_1 and S_2 were randomized. Following discrimination training (72 trials to each stimulus), Ss received 24 extinction trials to S_1 , the stimulus associated with 500 mg reward for all groups during training. Minimum GB detention time was 20-25 sec, and the intertrial interval averaged 18 min.

A retrace was recorded when S completely reversed its forward locomotion to the GB, and returned toward the SB. Only the first retrace on any trial was counted, and retraces occurring in the PSB and GB were not included in the results.

RESULTS AND DISCUSSION

The retracing pattern to S_2 over the course of discrimination is shown in Fig. 1. The early development of retracing in Groups 500:37 and 500:0 suggests a stage of training when strong generalized approach tendencies (r_R 's) and small reward or nonreward-produced anticipatory avoidant tendencies to S_2 are in competition. A comparison of these retrace data with the runway speed data (MacKinnon, 1967) reveals that the greatest incidence of retracing in Groups 500:37 and 500:0 (Blocks 3 and 4)

Fig. 1. Total number of retraces to S_2 during discrimination training.

coincides with the development of discrimination in the start measure, as evidenced by a sharp decrease in starting speeds to S_2 . The data shown in Fig. 1 include only the first retrace on any individual trial, and although retraces in all segments are included here, most first retraces occurred in the initial segment of the runway. The general finding that the formation of a discrimination is concurrent with the development of competing responses to S_2 is compatible with a frustration interpretation.

There was almost a complete absence of retracing to S_2 in Groups 500:500, 500:250, and 500:90, although there is a slight indication of competing behavior in the latter group. Overall, Fig. 1 indicates that the number of retraces to S_2 is inversely related to the magnitude of reward associated with that stimulus. As for performance to S_1 (not shown), no retracing was seen in any group after the first few acquisition trials.

It is evident from Fig. 1 that following the early development of retracing in Groups 500:0 and 500:37, there is a gradual decline in the incidence of retracing over the course of discrimination training. The decrease in retracing over the latter trials suggests that stimulation associated with anticipatory small-reward-produced avoidance tendencies (Group 500:37) or with nonreward-produced frustration (Group 500:0), becomes conditioned to approach with extended training.

Although this interpretation is consistent with the running speed performance of Group 500:37 (MacKinnon, 1967), an examination of the speed data for the simple discrimination condition (Group 500:0) reveals that the effect of frustrative factors varies with alley segment. As the incidence of retracing decreases over Trial Blocks 4-8, inc. (Fig. 1), start speed to S_2 shows a slight increase, whereas running and goal speeds decline. The increase in start speed to S_2 may be accounted for by assuming that strong generalized r_R is present when S_2 is initially encountered. The interaction of this generalized r_R and r_F may provide the condition for the facilitatory effect of frustration (i.e., $s_F \rightarrow$ Approach). On the other hand, running and goal performance reflects, essentially, "post-discriminative behavior" and is controlled mainly by strong avoidance tendencies (i.e., $s_F \rightarrow$ Avoid). In other words, $s_F \rightarrow$ Avoid is the dominant tendency once the initial response to the discriminative cue has been made.

Retracing to S_1 over the 24 extinction trials is shown in Fig. 2. The five groups differed significantly beyond the .001 level ($F = 23.79$, $df = 4/55$) and subsequent individual comparisons of the group means by Duncan's multiple-range test (Edwards, 1960) revealed the following: Groups 500:500 and 500:250 differed significantly ($p < .05$) in mean number of retraces, and both these groups differed ($p < .05$) from the other three groups. Differences

Fig. 2. Total number of retraces to S_1 for the five groups in extinction

among Groups 500:90, 500:37, and 500:0, however, were not reliable.

These results indicate a rough inverse relationship between the incidence of retracing to S_1 in extinction and the number of retraces made to S_2 during training. Presumably, fewer competing responses should occur to S_1 in extinction for the groups which had learned to approach S_2 in the presence of strong anticipatory small-reward-produced frustration cues during training (Groups 500:90, 500:37, and 500:0). Similarly, S_s trained to approach S_2 in the presence of relatively weak cues (Group 500:250) or in the

absence of such cues (Group 500:500), should exhibit the highest incidence of competing behavior in extinction.

Although the above data do not warrant a conclusive statement on the role of competing responses in differential magnitude of reward discriminations, there is an obvious consistency between these findings and theoretical assumptions based on frustration theory. However, further research employing more specific quantification of various competing behaviors is necessary in order to provide a comprehensive competing response interpretation of performance in differential reward magnitude discrimination.

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NOTES

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