Discrimination facilitation as a function of differential choice-point delay*

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Sixty rats experienced differential delay contingencies to ascertain how cue visibility related to choice-point delay in a black-white discrimination problem. Ss experiencing no delay at the choice point took longer to learn the discrimination than Ss experiencing cue visibility during an enforced choice-point delay. Cue visibility during the whole 4-sec delay period, first half of the delay period, and last half of the delay period, produced similar learning rates. The data indicate that the delay vs "stirred-up" state controversy is more complex than would be suggested by an analysis based on cue visibility time or "stirred-up" state of an animal.

Muenzinger has observed (Muenzinger & Newcomb, 1936; Muenzinger & Fletcher, 1936) that electric shock or jumping a gap at a choice point accelerates the acquisition of a black-white discrimination habit. Since rats paused at the choice point with both kinds of punishment, Muenzinger concluded that these obstacles caused Ss to slow down and, as a result, increase their exposure to relevant discriminanda. Thus, it is reasonable to assume that the rats acquired the visual discrimination faster because the punishment increased the probability of differential stimulation at the choice point (Logan & Wagner, 1965).

In an attempt to ascertain if the delay rather than the punishment was responsible for increased learning rate, Muenzinger used a T-maze (Muenzinger & Fletcher, 1937) in which two unframed glass doors were placed in the left and right alleys at the choice point. Acceleration of learning was not quite as pronounced with the physical barrier as it was with the shock and the jumping of a gap.

Honzik & Tolman (1938) replicated Muenzinger's jumping experiments and obtained similar results. They concluded, however, that it was not the pause that accounted for the acceleration, but rather a "stirred-up" reaction to the obstruction that made Ss more "vigilant" and therefore more responsive to stimuli. Thus, Honzik and Tolman maintained that the motivational state of S produced the acceleration of learning, while Muenzinger was committed to the viewpoint that the pause caused more differential choice-point stimulation of relevant cues.

The present study is concerned with some of the parameters of punishment and cue visibility during an enforced delay. The

effects of different kinds of choice-point delays were studied in relation to the rate of habit acquisition to ascertain if conditions of delay that can lead to varied motivational states are as important as cue visibility during the delay period.

SUBJECTS

Sixty naive male albino rats (90 to 120 days old) served as Ss for this experiment. The Ss were individually housed and given one Wayne Lab Blox pellet (3 cm) after each training session. Water was freely available in each S's home cage.

APPARATUS

The apparatus was a gray straight alley runway that terminated in a two-choice goal compartment. The runway section was 232.4 cm long and 7.6 cm wide. The goalbox was 49.5 cm long and 30.5 cm high, and it was divided into two equal-sized compartments. Training doors located immediately in front of the goalbox were used to ensure that S entered the appropriate compartment during pretraining. A sliding door (10.2 x 15.2 cm) located 203.2 cm from the start of the runway was used in preliminary training to prevent Ss from retracing their paths after they reached the choice point. During the experiment proper, two clear guillotine-type doors (8.9 x 15.2 cm) were used. They were located at the entrance to the goalbox. The second door was 2.54 cm behind the first door. Cards could be placed over the first or the second door to block S's view of the discrimination cues. Appropriate electromagnetic circuitry controlled the doors employed in the study. A more detailed description of the apparatus has been reported (Eifler, 1963).

PROCEDURE

During the first 17 days, Ss were handled and allowed to traverse the runway leading to the goalbox. For the first 5 days, Ss were placed on a table, 20 Ss at a time, for 30 min a day. Food in the

form of wet mash was present at all times. At the end of the 20-min period, Ss were placed in their individual cages and given the daily Wayne Lab Blox allotment. The Ss were then randomly assigned to five equal groups. Half of the Ss in each group were trained on a white-positive discrimination and the other half were trained on black-positive. During the next 4 days, one group at a time was placed in the apparatus and allowed to explore freely for 15 min each day. The following 5 days consisted of training each rat to negotiate the runway and push under the two gray doors that were hinged at the entrance to the goalbox. For the last 3 days of the pretraining period, each S was given 10 trials per day in the apparatus. On these pretraining days, S was required to make an equal number of right and left choices by means of the forcing doors. No more than two identical free responses in succession were allowed. The training door was employed when necessary to prevent retracing. Wet mash was present in both compartments of the goalbox throughout preliminary training.

The five experimental groups experienced the following training contingencies during the experiment. The control group ran from the beginning of the runway to the goalbox with no enforced delay prior to the discriminanda. A second group was delayed at the choice point for 4 sec by an opaque door that prevented visibility of cue stimuli. The third group was delayed for 2 sec with the opaque gray door, followed by 2 sec with the clear plastic door. The fourth group was delayed at the choice point by a clear plastic guillotine-type door for 4 sec. Finally, the fifth group was delayed at the choice point for 2 sec by a clear plastic door, followed by 2 sec with an opaque gray door. The following orders were used to designate the rewarded side of the goalbox: RLLRRLRLR followed on the next day by LRLRLRLR. When a choice was made, each S was contained in the goalbox for 20 sec. Wet mash was present in a gray cardboard liner that was inserted in the goalbox. The criterion for all groups was 19 errorless trials on 2 successive days.

RESULTS

Separate analyses of variance on the number of trials to criterion, $F(4,50) = 5.15$, $p < .01$, and number of errors to criterion, $F(4,50) = 4.76$, $p < .01$, both indicated differences among the five groups. Table 1 depicts the mean trials to criterion and the mean errors for all of the groups.

In order to assess the differences among the groups, *t* tests were performed. The difference between the free-running

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Table 1
Mean Number of Trials to Criterion and Mean
Number of Errors for All Groups

Groups	Mean Trials	Mean Errors
Nonblocked, control	431	182
Blocked 4 sec with gray door	287	122
Blocked 2 sec with gray door, followed by 2 sec with clear door	253	102
Blocked 4 sec with clear door	233	98
Blocked 2 sec with clear door, followed by 2 sec with gray door	189	71

control group and the control group that was blocked for 4 sec by a gray door was not significant for the trials to criterion, $t(22) = 1.88$, $p > .05$, or the errors to criterion measure, $t(22) = 1.76$, $p > .05$. The differences between the free-running control group and the group that was first confined by the gray door and then confined by the clear door was significant for both measures, $t(22) = 2.43$, $p < .05$, respectively. No difference was obtained between the group that was blocked by the gray door and the group that experienced the gray door followed by the clear door, $t(22) = .83$, $p > .05$, and $t(22) = 1.01$, $p > .05$.

Additional t tests were performed to determine if either of the partial-visibility confinement groups was significantly different from the confined group that could view the discrimination cues for the whole confinement period. No significant differences were obtained for either measure when the group that was confined with visibility during the confinement period was compared with the group that had cue visibility for the first half of the confinement period, $t(22) = 1.02$, $p > .05$, and $t(22) = 1.40$, $p > .05$, or when it was compared with the group that had cue visibility for the second half of the confinement period, $t(22) = 1.07$, $p > .05$, and $t(22) = 0.20$, $p > .05$.

DISCUSSION

The present study suggests that both cue visibility and a "stirred-up" reaction to choice-point obstruction play a role in determining learning rate. The cue-visibility explanation appears to gain support because the Ss experiencing the delay without visible discrimination cues did not learn at a significantly faster rate than Ss experiencing no delay. Since the group experiencing the delay without cues did not differ from the group that viewed the cues for the second half of the delay period, the data also suggest that delay independent of visibility might play a role in determining learning rate. The significant difference between the control group that experienced no delay and the group that viewed the cues for the second half of the delay period indicates that delay coupled with cue visibility produces an increased rate of learning.

The three groups that had cue visibility for part or all of the delay period took the smallest number of trials to learn the discrimination and did not differ from each other statistically. It would be erroneous to conclude that these three groups suggest cue visibility plays a greater role than that of a "stirred-up" state. This becomes obvious when one observes that the group that had the cues blocked for only the first half of the delay did not differ statistically from the group that was blocked with the gray door for the whole delay period. In addition, a cue-visibility explanation would indicate that the group viewing the cues for the whole delay period would learn faster than the group that viewed the cues for the first half of the delay. The data do not go in the direction suggested by a cue-visibility explanation. Even though the inversion in the two groups (cue visibility for the whole delay and cue visibility for the first half of the delay) was not statistically significant, it is important to attend to the slower learning rate in the group that experienced cue visibility during the whole delay period.

It is possible to posit that initial

exposure followed by blind blocking induces an intensified "stirred-up" state. This intensified emotional reaction could lead to the fastest learning rate in the group that experienced the discrimination cues for the first half of the delay period.

It is also plausible to assume that something analogous to reactive inhibition could build up as Ss make adjustments and anticipatory postural responses while viewing the discriminanda. If the inhibition dissipates when the relevant cues can no longer be observed, Ss that are not allowed to view the stimuli during the last half of the delay period should learn more rapidly than Ss who view the stimuli for the whole delay period. A reactive inhibition explanation does not detract from a cue-visibility (as opposed to a "stirred-up" state) interpretation of the results.

Apparently this issue is more complex than an analysis based on cue-visibility time or the "stirred-up" state of an animal would suggest.

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