Rapid acquisition of a Sidman avoidance response*

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Rats were trained on a Sidman avoidance task with a 22-sec R-S and a 6-sec S-S interval for six daily 30-min training sessions. Disabling the response lever during and 0.5 sec after shock termination represented one factor in the 2 by 2 factorial design and the presentation of a feedback light cue accompanying an effective response was the other. Rats in the lever-disable condition with feedback light made significantly more avoidance responses than the other treatment groups. In a second experiment, daily 60-min sessions were observed. Using a lever-disable plus feedback light treatment, rats made more avoidance responses and received fewer shocks during the second 30-min as opposed to the first 30-min period.

Problems associated with the acquisition of a Sidman leverpressing avoidance response have been noted by many Es (Meyer, Cho, & Wesemann, 1960; Ellen & Wilson, 1964; Weissman, 1962). Some investigators (Bolles & Popp, 1964; Leaf, 1965) have isolated training variables yielding high rates of avoidance responding, but the problem still persists (Forgione, 1970; Riess, 1970). Shaping procedures usually increase the percentage of animals that successfully avoid, but these procedures are time consuming and inefficient if large numbers of animals must be conditioned.

Two response patterns that interfere with rapid avoidance conditioning are (1) holding and (2) responses which occur immediately upon shock onset. When holding, the rat keeps the lever in a depressed position during the response-shock (R-S) interval and maintains that position until the next shock occurs. The second pattern [Forgione's (1970) short latency response to shock onset] frequently occurs if the rat is maintaining a holding response. With the onset of shock, the rat rears and jumps, thereby releasing the lever, but falls back on the lever, initiating a response that aborts the shorter shock-shock (S-S) interval and starts a new R-S interval. If this response pattern occurs at the end of each R-S interval, it is instrumental in reducing shock density, but it precludes the acquisition of more rapid and efficient avoidance responding. By introducing a timer that briefly disabled the lever during and shortly after shock, Forgione (1970) facilitated avoidance conditioning.

Other investigators have reported that visual (Bolles & Grossen, 1969; Leaf, 1965; Weissman, 1962) or auditory (Bolles & Popp, 1964) response feedback substantially

influences avoidance acquisition. The present study was concerned with evaluating these experimental procedures to determine if the acquisition of a Sidman avoidance response could be accomplished without resorting to lengthy preliminary shaping procedures.

METHOD

Subjects and Apparatus

Twenty-four male Sprague-Dawley rats, weighing 192-224 g, were used. All animals had continuous access to food and water.

The conditioning apparatus consisted of two rectangular plastic chambers, 20 cm wide, 15 cm deep, and 13 cm high, with a floor of stainless steel rods spaced 1.25 cm apart. A Lehigh Valley Electronics Model 1352 rat lever was situated in the middle of one of the 15-cm walls. The lever penetrated 2.1 cm into the chamber, and the top of the lever was 5 cm above the grid floor. A 7-W bulb served as the houselight. The bulb was located on the outside of the chamber's plastic ceiling, directly over the lever. Grid shock was provided by Grason-Stadler Model E1064GS shock scramblers. Electromechanical equipment controlled stimulus events and recorded the occurrence of leverpress responses. Both conditioning chambers were enclosed in sound-attenuating enclosures.

Procedure

Rats were individually placed in the conditioning apparatus for 1 h daily for 6 days. During the first and last 15-min periods, the avoidance schedule was not in effect and the houselight was on. During the 30-min avoidance period, the houselight was off and a 0.5-sec 0.5-mA shock was presented every 6 sec (S-S interval) unless a leverpress occurred, which postponed shock for 22 sec (R-S interval). Rats were assigned randomly to four treatment groups. In Group I the lever was disabled for 1.0 sec, commencing with shock onset and terminating 0.5 sec after shock offset. Responses during this 1.0-sec period were ineffective. Effective responses were accompanied by a 40-msec light stimulus from the houselight. Cue light presentation was programmed via the 40-msec output pulse of one of two Grason-Stadler pulse formers attached to the lever. The output of the other pulse former was connected to a digital counter and cumulative recorder. Rats in Group II were subjected to the lever-disable condition but did not receive the cue light feedback for effective responses. In Group III the lever was never disabled and all responses were followed by the cue light. Neither cue light nor the lever-disable condition were in effect for rats in Group IV.

RESULTS

The mean responses emitted and shocks received by the four treatment groups are illustrated in Fig. 1. Disabling the lever and providing a cue light resulted in a greater number of avoidance responses for Group I ($F = 3.45$, $df = 3/20$, $p < .05$). Group I animals made significantly more responses during the first and second sessions than the other three groups. During the third and fourth sessions, Group I animals performed significantly better than Group II and IV animals. Group I rats also received significantly fewer shocks compared with the other three groups during the first session; during subsequent sessions, significant

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Fig. 1. Mean responses and shocks per minute for consecutive daily 30-min sessions.

differences were observed only between Group I and Group II animals. The absence of a lever-disabling condition for rats in Groups III and IV may explain the low number of shocks received by these animals. The responses of these animals were characterized by the short latency to shock onset pattern which effectively reduced shock density but did not lead to a high response rate. Responses by rats in Group II were also characterized by the short latency to shock onset. With the lever-disable condition in effect, however, the number of shocks increased significantly. Without a cue light to facilitate discrimination between an effective and a noneffective response, the number of avoidance responses remained low. Thus, the interaction of a feedback cue light and lever-disabling operation provided the best conditions for yielding high response rates and low shock density.

The daily avoidance sessions were relatively short (i.e., 30 min) and a warm-up effect was noticed, especially for Group I. In order to observe the relative effect of 1-h avoidance sessions, six additional rats were given the same treatment as Group I animals (i.e., lever disable and feedback cue light available) for six daily 1-h avoidance sessions. Responses and shocks were recorded after 30 and 60 min for each session. These data are presented in Fig. 2. In all six sessions, animals made more responses and received fewer shocks during the second 30-min period as compared to the first 30-min period. Mean response values were lower and mean shock values were higher in this study. These differences were partly attributable to one animal in the second study that made very few avoidance responses and received many shocks for all six sessions.

Fig. 2. Mean responses and shocks per minute for six daily 1-h avoidance sessions. Data for each session are illustrated for the first and second 30-min periods of each 1-h session.

DISCUSSION

The present data suggest that preliminary response shaping is not necessary for establishing a Sidman avoidance response if a lever-disabling condition is utilized. However, the value of a lever-disabling condition is useful in eliminating the press-release response topography only if there is an immediate exteroceptive stimulus consequence for the effective response. Group II animals, subjected only to the lever-disable condition without the feedback light, made fewer avoidance responses than Group I. Only when the lever-disable condition was accompanied by the feedback light condition (as in Group I) did an increase in avoidance behavior develop. These results support the findings of other studies (Bolles & Grossen, 1969; Leaf, 1965; Weissman, 1962).

There is some question regarding the extent to which these findings could be replicated using unmodified commercially fabricated conditioning chambers to train rats on a Sidman avoidance schedule. Most commercial conditioning chambers are designed for appetitive conditioning, and the response levers are located 7 cm or more above the grid floor. The response levers in this study were only 5 cm above the grid floor and may have facilitated avoidance responding. This notion is reinforced by Leaf (1965), who used a lever located only 1¼ in. above the floor and reported a response rate of 6.1 responses per minute¹ for rats on a 20-sec R-S and a 5-sec S-S interval.

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NOTE

1. This response rate was extrapolated from Leaf's data, since only group avoidance response values were reported as mean total responses for one 6-h acquisition session.

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