Two methods of increasing response rate in free-operant avoidance conditioning[1]

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Rats with extremely low response rates in a free-operant avoidance paradigm were subjected to altered experimental conditions involving either increased intensity or increased duration of shock relative to previous baseline conditions. Both changes resulted in a gradual increase in response rate. It is suggested that duration of shock be further investigated as a manipulatable variable contributing to the total stimulus complex of the free-operant avoidance paradigm.

An important characteristic of performance in the free-operant avoidance situation is the great variability in acquisition response rates between animals. While some rats respond rapidly in the early phases of the experimental session, others make few responses initially, but gradually increase their rate of responding. Still others virtually do not respond at all, consequently, they fail to avoid shocks after 8 to 10 h in the experimental situation. These "problem Ss" are of special interest in that they demand investigation of effective means by which response rates may be increased.

Several antecedent conditions have been shown to affect response rate, any of which may be used to facilitate the acquisition response rates for "problem rats." Among these are the shock-shock interval, response-shock interval and intensity of shock.

Sidman (1953, 1966) presented data which suggested that response rate may be increased by manipulating shock-shock and response-shock intervals. In general, acquisition is more rapid when the shock-shock interval is considerably shorter than the response-shock interval. The effect of reducing the response-shock interval is greater with short shock-shock intervals than with long ones. Similarly, the effect of reducing shock-shock intervals is greater with short response-shock than with long ones. Shock intensity as a variable in free-operant avoidance has been studied by Boren, Sidman, & Hernstein (1959) who showed that as intensity of shock is increased, the rate of avoidance responding is also increased. In general, increases in response rate were greatest with increases in intensity between zero and one milliampere (mA). There was little increase in rate beyond 1 mA even when the intensity was increased as high as 3.2 mA.

Little consideration has been given to duration of shock as a means of increasing response rates in a free-operant avoidance situation. The use of the conventional 0.2 and 0.3 sec durations (Sidman, 1962; Verhave, 1962) is based mainly on the advantages offered by its brevity. Shocks of longer durations characteristically yield more skeletal reactions than shocks of shorter durations. Thus, shorter durations are used to afford protection against the possibility of reduced response rates due to the incompatibility of the skeletal reactions and the bar-pressing response. Short durations also decrease the probability that a response will be made during the time that the shock is on, thereby decreasing the probability of confounding avoidance and escape behavior. The present study investigates the effectiveness of increasing duration of shock and shock intensity as a means of increasing response rates of problem rats in a free-operant avoidance situation.

Subjects. The Ss were two male Long Evans hooded rats. Both rats were previously in a nutrition study in which they were exposed to the Sidman-type avoidance situation for 11 daily 1 h sessions. Their selection for the present experiment was based on the fact that neither rat had given more than 10 responses during any one of the previous experimental sessions. At the start of the experiment both rats were 65 days old.

Apparatus. The apparatus was an 8½ x 7½ in. modified two-response Skinner box with a 1-1/8 x 1-1/4 in. stainless steel bar protruding 9/16 in. into the box (the second bar was removed). The floor of the box was composed of 17 stainless steel bars 3/32 in. in diameter, spaced on ½ centers. The walls of the box which were parallel to the steel bars were constructed of stainless steel, and ¼ in. Plexiglas formed the other two sides. Shock was provided by a Grason-Stadler shock generator and scrambler (Model E1064GS) designed to change the polarity of the bars at the rate of 100 changes per sec. Other equipment, including a system of relays, timers, recorders, etc., controlled the automatic recording and presentation of shock and tone.

Procedure. In the previous nutrition experiment, each rat was given a shock of .5 mA intensity and .2 sec duration every 3 sec for 11 consecutive daily sessions. Each press of the bar during the 3 sec shock-shock interval postponed the shock and initiated a tone that lasted 15 sec. Any response during the 15 sec response-shock interval reset the response-shock interval back to 15 sec. Thus, each response was followed by 15 sec of tone during which no shocks were received. The conditions of the present experiment, a continuation of the previous one, were identical except that the shock was increased from .5 to 1 mA for one rat (No. 140) and the duration of the shock was increased from .2 to .5 sec for the other rat (No. 108). Each rat was given daily 1-h sessions for nine consecutive days.

Results. The performance of both rats in the nutrition experiment was used as baseline for the present experiment. The baseline and experimental data for both rats are shown in Fig. 1. Although Rat 140 made as many as nine responses in a 1-h session of baseline, there is no evidence of increases in rate over the eleven sessions. Following the increase in intensity effected on Day 12, the response rate gradually increased over the nine remaining sessions and leveled off between 312 and 327 responses per h. Similarly, Rat 108 failed to make more than two responses per h during the baseline sessions. A gradual increase in rate also followed the increased duration of shock. Response rate increased to a high of 240 responses per h, but leveled off between 208 and 226 responses per h.

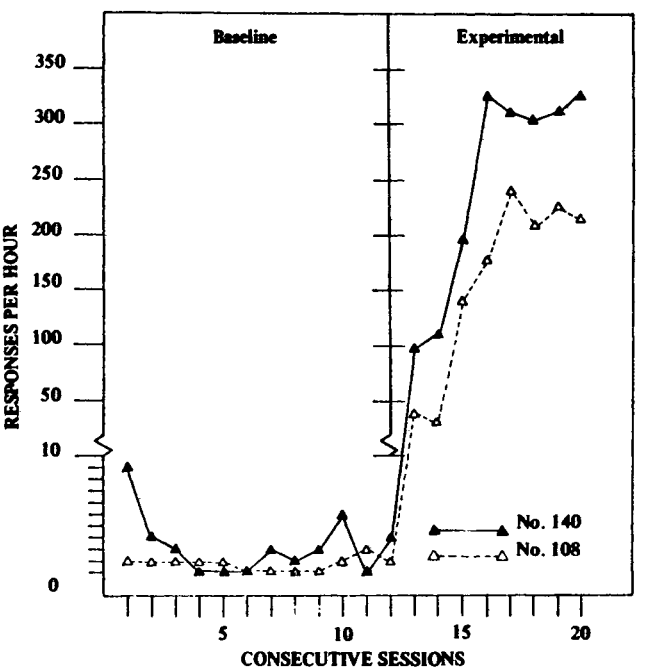

Fig. 1. Responses per hour plotted over 20 consecutive sessions.

Discussion. Increases in both intensity and duration of shock had the effect of increasing response rate in the Sidman-type free-operant avoidance paradigm. While there is no attempt to compare these two methods, the experiment does demonstrate the feasibility of using either or both methods to increase the response rates of problem rats. More importantly, the results imply that there may be some optimal combination of intensity and duration of shock that will be most effective in rapidly establishing stable baseline performance. Finally, the experiment points to the need to give more consideration to the duration of shock as an effective variable contributing to the total stimulus complex. As such, duration of shock can be manipulated and utilized in the attempt to establish the desired behavior in the most efficient manner. An important contribution to the free avoidance literature would be the empirical designation of the duration value beyond which avoidance behavior becomes significantly confounded with escape behavior. Specification of this value would require increasing duration while recording both rate and frequency with which responses are emitted during the administration of shock.

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NOTES

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