Rat avoidance behavior in a dual, one-way shuttle apparatus

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Rats conditioned to avoid shock under a bidirectional avoidance schedule imposed over a conditioned one-way avoidance response in a dual, one-way shuttle-box attained high asymptotic levels of avoidance while maintaining an incremental rate of acquisition.

The rapid, non-incremental acquisition and high asymptotic levels of discriminated avoidance responses by rats conditioned in various one-way (unidirectional movement from one chamber or area to another) shuttle-boxes have been widely substantiated (Baum, 1965; Clark, 1966; Maatsch, 1959; Tenen, 1966; Theios, 1965). However, the acquisition of discriminated avoidance responses by rats in various forms of two-way (bidirectional movement between two chambers through a single two-way opening) shuttle-boxes has been characterized by slow, incremental rates of acquisition and low asymptotic levels of performance (Bindra, 1961; Moyer & Chapman, 1966; Theios & Dunaway, 1964; Vanderwolf, 1963). It has been suggested that the poor performance obtained in bidirectional shuttle-boxes is due to non-avoidance conditioned responses (freezing, rearing, etc.) which are exhibited by Ss when performing two-way shuttle avoidance (Baum, 1965; Ray, 1966a; Theios & Dunaway, 1964).

These conditioned non-avoidance responses have been successfully counter-conditioned by modifying the two-way shuttle-box facilitating the rapid, high performance behavior normally obtained with one-way techniques (Baum & Bobrow, 1966; Ray, 1966b). These modifications and other parametric manipulations have been designed to condition the Ss rapidly to high levels of performance, but few reports, excluding direct physiological changes of the experimental Ss, have

suggested methods for improving the low level of performance without altering the incremental rate of acquisition. This report describes such an experiment utilizing an automated dual, one-way shuttle apparatus.

Apparatus

The shuttle-box (Fig. 1), constructed of 1/4-in. Plexiglas and painted black, consisted of two compartments interconnected by two tunnels. The top of each chamber was hinged permitting placement of the S in either chamber. Access to an opposite chamber was by passage through a Plexiglas one-way door and a tunnel; each door was lockable by means of a damped rotary solenoid. Photocells (GE B-1035) situated near the end of each tunnel perceived the location of the S in the apparatus, operated remote relays (Sigma 8000S-SIL), and controlled the program. A buzzer and a light were mounted together on each end of the apparatus. The shuttle-box was mounted on a detachable grid of 1/8-in. stainless steel rods spaced at 5/8-in. intervals divided into two sections; a separate shocker supplied scrambled 1000 V, 2.5 mA current to each section. The complete unit was contained in a sound attenuated chamber isolated from the programming and monitoring equipment in an enclosed, darkened test room.

Subjects

Eighteen randomly selected, experimentally naive, Long-Evans rats, 120-150 days of age, served as Ss. They were housed in individual cages with food and water available ad lib.

Procedure

The continuous program consisted of a 15 sec. intertrial interval (ITI) and a 15 sec. buzzer and

Fig. 1. Floor plan of the dual, one-way shuttle-box utilized. The one-way doors, diagrammed as vertically hinged, were hinged horizontally overhead.

Fig. 2. Avoidance acquisition and extinction curve in terms of daily mean shuttle responses during CS presentation only for eighteen rats. Vertical ordinates represent range of values for each point.

light (CS) presentation in the chamber occupied by the S which was paired with the shock (US) during the last 5 sec. of the cycle. Avoidance of the US was possible during the first 10 sec. of CS presentation and escape during the last 5 sec.; both initiated an ITI.

Simultaneously with the CS, current to the grid opposite S was turned on, prohibiting the S from avoiding the US by standing in the tunnel. The one-way door, functioning as a switch, temporarily interrupted this current when the door was opened and prevented the S from being inadvertently shocked during avoidances or escapes; permanent removal of the current was a function of the photocells that controlled the program and recorded all avoidances and escapes. The door leading to the opposite chamber was locked during the ITI.

Fifty CS presentations were given daily to each S.

Results and Discussion

The acquisition data, expressed as daily mean percentages and ranges of avoidance during presentation of the conditioning stimulus, are presented in Fig. 2. Escape data, except for Day 1, are represented in the acquisition portion of the graph in Fig. 2 as the difference between percent avoidance and 100%; on Day 1, the Ss performed a mean of 11.3 trials (range 2-28) before escaping the US. Extinction data, obtained by removing the shock contingency, are also graphically presented in Fig. 2.

All rats acquired a high level of conditioned avoidance without altering the gradual rate of acquisition. Acquisition was characterized by oscillatory behavior between avoidance and escape as previously reported

(Theios & Dunaway, 1964; Atkinson et al, 1965) which may have been due to superimposing the bidirectional avoidance schedule on an essentially conditioned one-way avoidance situation. The fact that the Ss had to discriminate between two different doors may have been a factor contributing to the gradual acquisition as well as the relatively high number of trials before attaining escape behavior on the first day.

The high asymptotic performance levels were attributed to conditioning Ss to the one-way response. Any non-avoidance responses that may have been conditioned were apparently counter-conditioned. This is suggested from the high levels of performance (Ray, 1966a).

Extinction was accomplished rapidly once each S failed to respond to one or two complete CS presentations and was characteristic of extinction obtained with conditioned discriminative avoidance schedules. There was a wide range of trials (13-294) before extinction was manifested by all Ss.

Since the method demonstrates the feasibility of attaining high asymptotic behavior without altering the incremental acquisition normally observed with a bidirectional avoidance schedule, it provides a convenient means for studying the effects of independent variables (such as drugs) on rate of acquisition and asymptotic avoidance performance.

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