Rotation as an aversive stimulus for rats¹

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Rotation paired with a warning signal using a CER procedure failed to produce conditioned suppression in rats on VI 30 or FR 50 schedules. Conditioned suppression of responding on the FR schedule was obtained when the onset of rotation was contingent upon responding during the signal (discriminative punishment).

Although systematic explorations of several parameters which affect the learning of a Conditioned Emotional Response (CER) have been conducted (Annau & Kamin, 1961; Kamin & Brimer, 1963; Stein et al, 1958), little evidence is available on the effects of aversive stimuli other than electric shock (Solomon, 1964). Animal and human studies have shown that vestibular stimulation induced by rotation is a noxious stimulus capable of disrupting physiological and behavioral processes (Graybiel et al, 1960; Meek et al, 1962; Riccio, 1965). This experiment attempted to condition the suppression of bar pressing in rats by using rotation as the noxious stimulus.

EXPERIMENT I

Method

Two adult male albino Sprague-Dawley rats, maintained at 75% of ad lib weight, were trained to stable levels of performance on FR 50 and VI 30 sec. schedules of food reinforcement (45 mg pellets) in a standard Gerbrands chamber fixed over the center of a turntable. The reinforcement schedule and CS and UCS presentations were controlled by standard programming equipment through a slip ring device. Prior to CER training, CS produced no observable effect on Ss behavior. The CER procedure was as follows: The CS, an 82 dB buzzer mounted on the cage, began 3 min. prior to the UCS and continued until UCS ceased. The UCS consisted of rotation at 20 RPM for 1 min. (After 21 trials, the UCS was increased to 2 min. for the VI 30 rat.) Ss received 5-9 daily pairings at irregular intervals in 2 hr. sessions for 18-22 days. CER was measured as the ratio of the number of responses during CS to the number during the preceding 3 min. period. A similar suppression ratio was used to determine the UCS effect.

Results

The upper portion of Fig. 1 shows that no conditioned suppression occurred after even 160 pairings while the lower portion indicates that UCS effectively disrupted bar pressing by reducing response rates by 80-100%.

EXPERIMENT II

The failure to produce CER raised the question of whether there were any conditions in which a stimulus paired with rotation would have an effect on behavior. Pilot work with another rat indicated that suppression could be obtained with a punishment contingency.

Method

After 5 to 10 trials with the buzzer to extinguish any buzzer-rotation association, the same two Ss were trained as follows: The CS began immediately after a reinforcement and the UCS (rotation at 20 RPM for 1 min.) began as soon as 10 responses were emitted in 90 sec. If less than 10 responses occurred in 90 sec., the CS was terminated and no UCS introduced. Thus, responding was punished

Fig. 1. Median suppression ratios to the CS and UCS.

by UCS presentation while not responding allowed Ss to avoid rotation. After 22 trials, the extent of stimulus control in the FR rat was further determined by introducing CS after either reinforcement (0 position) or the 10th or 20th response in the ratio. Three pairings at each of the three positions were given daily in a scrambled sequence for 10 days.

Results

Median pause time, defined as the time following reinforcement until emission of the 10th response, was

Fig. 2. Median pause time ratios to the discriminative stimulus in the punishment contingency.

Fig. 3. Median pause times of the FR rat as a function of the position of the CS in the ratio.

determined for periods prior to and during CS presentation. The suppression effect of each CS is the ratio of pause time during buzzer to pause time without the buzzer. Thus, an increased ratio indicates greater suppression. Figure 2 shows that while the VI rat exhibited no conditioned suppression, the FR rat showed rapid acquisition of increased pausing during the buzzer, reaching a nearly asymptotic level with 30 pairings. Figure 3 presents the median pause time for the FR rat as a function of the position of the CS in the ratio on the first and last three days of this condition. The initial gradient may reflect the 22 previous presentations of CS in the 0 position.

Discussion

The failure of rotation to produce CER suppression contrasts with the relatively rapid CER acquisition to shock under similar reinforcement schedules (Brady, 1955) but is consistent with low intensity shock data (Annau & Kamin, 1961). The continued disruption of responding produced by the UCS indicates that Ss had not simply habituated to rotation.

Unlike CER, rotational punishment with a discriminative stimulus was effective in conditioning suppression on the FR schedule. This agrees with Azrin's finding (1956) that response-correlated shock in the presence

of a discriminative stimulus produces greater suppression of responding than response-independent shock, and with the report (Annau & Kamin, 1961) that low level shock, ineffective for CER acquisition, produces conditioned suppression in a punishment situation. Although the failure to condition suppression by punishment in the VI rat may reflect individual differences, the reinforcement schedule generating the baseline behavior seems a more likely variable since suppression was obtained in two cases (this and a pilot S) on FR schedules. When the CS is initially presented after reinforcement on the FR schedule, the typical low probability of responding may facilitate the acquisition of conditioned suppression. Once suppression was learned the CS then exerted considerable control over behavior even during the high terminal rate of the FR schedule. Thus, under the appropriate contingencies, rotation can function as an aversive stimulus to produce learning in rats.

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Notes

1. Sponsored by the Office of Life Science Programs, NASA & the U. S. Navy. Opinions are not necessarily endorsed by the Navy Department.