Forced activity and conflict behavior

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Twenty-seven male albino rats were trained to run a short runway and lick a 16% sucrose solution. Next, an approach-avoidance spatial conflict was established in the animals by giving five avoidance trials in which licking the goal cup resulted in electric shock. Immediately following each of the avoidance trials, Ss experienced either heavy, light, or no forced running activity in another apparatus. The effect of this interpolated activity was assessed by measuring approach behavior on each of the avoidance trials and on a recovery trial following a 12-h rest. Running activity first increased then decreased avoidance behavior, and the amount of facilitation or interference was proportional to the amount of activity.

The present study represents an attempt to determine the effects of forced activity (running) upon the performance of rats in a spatial conflict situation. Animals were trained first to approach then to avoid a goal area. The effects of interpolated forced activity of varying degree upon subsequent approach behavior were assessed, both during the avoidance phase itself and following a recovery period.

SUBJECTS

Twenty-seven male Cheek-Jones albino rats, 150 days old, were assigned randomly to three groups of nine Ss each. The Ss were caged individually and were allowed unlimited access to water.

APPARATUS

Two experimental spaces were employed. The first ("conflict") apparatus was an unpainted wooden runway, $3\frac{1}{2} \times 6\frac{1}{4} \times 32$ in. The runway was covered by a hinged, clear plastic top, and was floored with $\frac{1}{8}$ -in. stainless steel grid bars spaced $\frac{1}{4}$ in. center to center. A goal cup (aluminum teaspoon) was centered on the end wall, $1\frac{1}{4}$ in. above the floor. The goal cup and grid formed the two poles of a circuit which could be electrified by a fused, variable-voltage autotransformer through a 10K fixed resistor.

The second ("activity") apparatus consisted of an inverted home cage suspended over a motor-driven turntable. The 28-in. diam turntable provided a horizontal, rigid cardboard running surface with a variable speed of rotation. The sides, top, and rear surfaces of the suspended cage were solid metal, and prevented escape from the turntable. The cage's front surface, toward

which the running animal was oriented, was $\frac{1}{2}$ -in. hardware cloth which permitted free vision of the cage exterior. A pilot study had indicated that such free vision facilitated running.

PROCEDURE

All Ss were first trained, under 23-h food deprivation, to approach the goal cup and lick 0.25 cc of a 16% (by weight) sucrose/distilled-water solution. The index of approach behavior was the time elapsing between the S's placement in the start area and its contact with the metal goal cup. The Ss were run to a criterion of 15 consecutive approaches with times less than 1 sec. The trials were massed, with an average intertrial interval of 30 sec.

Following approach training, five avoidance training trials were given in which S's contact with the goal cup delivered a 75-V ac shock to its tongue and paws. If an S did not contact the cup within a 4-min period, it was removed from the runway and assigned a score of 240 sec. The three groups received differential treatment in the activity apparatus during the periods immediately following each of the five avoidance trials. Group L (light activity) experienced a 6-min period of forced running, during which the turntable revolved at 8 rpm. Group H (heavy activity) experienced 6 min of forced running on a 19-rpm turntable. Group C (control) was merely placed on the stationary turntable for a 6-min period. Immediately following a placement or an enforced running period, the S was returned to the runway for

another avoidance trial. This process was repeated until five avoidance trials with five interpolated run or rest periods had been given each S.

Immediately following its fifth and last turntable exposure, each S was returned to its home cage and was fed 5 g of laboratory chow. Then, following a 12-h rest period in the home cage, each S was given a single recovery test in the runway, its approach time again being recorded. If an S did not contact the goal cup within a 4-min period, it was removed and was assigned a score of 240 sec.

RESULTS

All Ss rapidly acquired the approach response, the mean total number of training trials for all Ss being 17.2 trials. Figure 1 presents mean approach times for the three groups for the five avoidance trials and for the single recovery trial. All Ss ceased to approach (approach time greater than 240 sec) by the fourth avoidance trial. Although the mean approach times of the groups do not differ over all five avoidance trials, inspection of Fig. 1 reveals an interesting relationship. Enforced running impeded approach on the earliest test but facilitated approach on later tests. Moreover, the amount of interference or facilitation is directly related to the amount of enforced running (light vs heavy activity). The reliability of this graphic trend is indicated by a significant Groups by Trials interaction effect (Type I analysis of variance, $F = 2.19$, $df = 8/96$, $p < .05$), and by the fact that a pilot investigation of the same variables with a small number of Ss indicated exactly the same relationship.

The facilitating effect of enforced running activity following avoidance trials is

Fig. 1. Mean approach times for the avoidance and recovery trials.

seen even more dramatically in the single recovery test. Here, the control Ss recovered the approach response only slightly (only three of the nine Ss recovered), while recovery was substantial for Group L (seven of the nine Ss recovered), and was even greater for Group H (again, seven of the nine Ss recovered). The intergroup differences in the recovery test are significant, with Group H differing reliably from Group C (Duncan's Range Test, $p < .05$).

DISCUSSION

Although the mechanism of the observed effect is still unclear, the following hypothesis may be suggested. Let us assume that running activity is ordinarily not aversive, and is incompatible with fear. In the present experiment, however, running occurs under rather unusual conditions. The S is given an avoidance test trial, is immediately forced to run, is given another test trial immediately following running, and so on, i.e., the trials and interpolated activity are massed. Under these conditions, an aversive "defensive reaction" (see Lynn, 1966) might result from the novel and intense running stimulation which immediately follows a noxious experience in the avoidance apparatus. The S is then tested in the presence of the aftereffects of this defensive reaction.

The avoidance behavior displayed by the forced activity groups during the massed avoidance trials may represent a summation of the effects of two sources of aversiveness: (a) the electric shock and its accompanying conditioned emotional response, and (b) the aftereffects of a defensive reaction. This second source of aversiveness would be most intense very early in testing, at the time of the S's first exposure to shock, conflict, and the running activity apparatus. With successive exposure, the defensive reaction and its aftereffects would habituate. During the 12-h rest period, residual aversive aftereffects would dissipate, allowing the usual fear-incompatible properties of running activity to become evident.

It would be interesting to determine whether running or other types of activity would reduce fear which was produced and measured in other ways. The influence of activity on other emotional states might also be investigated. Frustrating events have been shown to produce increased response vigor, activity, and attack (Amsel, 1967; Gallup, 1965). What would be the reciprocal effect of these latter behaviors on frustration? Some data that relate tangentially to this sort of question have been presented very recently by Moyer (1968), who has preliminary evidence which indicates that aggression circuits may be desensitized by the expression of aggressive behavior.

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Electrically induced affective attack from the hypothalamus of the albino rat¹

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Electrically induced mouse killing was elicited by stimulation of the anterior lateral hypothalamus. Rats learned to press a bar to escape current levels that yielded attack. Attack latencies increased as test chamber size increased. With repeated testing sessions the vigor and amount of aggression decreased and sometimes disappeared with no corresponding decrease in escape behavior.

Among the behavior patterns elicited by electrical stimulation of the hypothalamus in the rat are eating, drinking, hoarding, maternal behavior, and increased sexual activity. Despite the observation that rats often attack and kill mice [(muricide) Karli, 1956], no evidence of centrally induced attack has been reported for the rat. Stimulus-bound attack, however, has been studied extensively in the cat. It has been divided behaviorally into affective attack and stalking attack (Wasman & Flynn, 1962) for which the more general motivational correlates are escape (Adams & Flynn, 1966) and approach (Roberts & Kiess, 1964), respectively. The present report describes the preliminary results of stimulus-

bound affective attack elicited from the hypothalamus of the albino rat.

METHOD AND RESULTS

Animals were initially screened for muricide by leaving one albino mouse in the home cage of each rat. Only rats which did not kill the mouse in a 24-h period were implanted with bipolar electrodes aimed for selected areas of the hypothalamus. Each pole of an electrode was .23 mm in diam and insulated except for the cross-section of the tip. After surgery Ss were screened in a 45 x 40 x 44 cm Plexiglas observation box. As possible goal objects of motivated behavior a live mouse, a dead mouse, two wedges of wood, and several food pellets were placed in the box during screening. Brain stimulation (60-cycle ac) was automatically programmed to be on for 25 sec and off for 50 sec. Current was systematically varied each cycle and the motivational concomitants of stimulation were recorded. Of a total of more than 80 rats tested in this manner, we have observed stimulus-bound attack in 10 animals. This report is primarily based on data from these Ss.

In rats with effective electrode placements the aggressive behavior was similar to what has been described as affective attack in cats. Attack was usually undirected and normally occurred when the paths of the rat and mouse crossed. Directed attack was observed to occur, however, if the rat was