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Activity level and secondary motivation: Fear*

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Four groups of eight rats received either no shock or 35-, 45-, or 55-V shocks in a runway equipped to allow measurement of activity immediately before a trial began. Suppression of activity (i.e., freezing) was significant for each shock group and was significantly and monotonically related to shock intensity.

The observation that an animal will freeze in many fear-arousing situations dates back to some of the earliest laboratory studies on fear (e.g., Estes & Skinner, 1941; Miller, 1948; Brown & Jacobs, 1949). Recently there has been a resurgence of interest in this phenomenon in both research and theory. For example, Bolles (1970, 1971) extensively and critically reviewed empirical research and theoretical interpretations of behavior in aversive stimulus situations, and concluded that an organism's strong tendency to freeze in those situations could account for many of the effects inadequately covered by existing explanations. Similarly, Blanchard & Blanchard (1969a, 1970) as well as Weiss, Kriekhaus, & Conte (1968) have argued that freezing (crouching) must be taken into consideration before any realistic analysis of active or passive avoidance learning could be completed.

Suggesting another research direction, Blanchard & Blanchard (1969b) investigated the use of freezing (crouching) as an index of fear. They report the successful use of an observer-rating system to measure crouching, and report a monotonic increase in crouching after shock as a function of shock intensity. The present experiment represents an attempt to extend this finding by replacing the observer-rating system with an automated measurement of general activity level. In addition, this measurement was taken in a chamber attached to the startbox of a shock-escape runway and was taken immediately before a shock trial. Thus, the fear measured was the response conditioned by the previous shock, but it also represented part of the organism's motivation for the subsequent trial.

METHOD

Subjects

The Ss were 32 male albino rats of the Sprague-Dawley strain purchased from Russell Miller Farms, Cazenovia, N.Y., and were 160-210 g at the beginning of the experiment. They were maintained in individual cages with ad lib food and water for the duration of the experiment.

Apparatus

The apparatus consisted of a dark gray runway (106 cm long x 11.5 cm wide x 20 cm high) with grid floor (.30-cm stainless steel bars spaced 1.25 cm apart). Above the starting end of the alley was an attached dark gray chamber (30 cm long x 11.5 cm wide x 17 cm deep) with a trap-door floor. A black, smooth-floored goalbox at the other end of the alley was 20 cm wide x 46 cm long x 20 cm deep. All sections had Plexiglas tops. Activity levels were monitored in the chamber above the startbox with an Alton Electronics ultrasonic motion detector, with the total number of output pluses recorded on a Hunter Klockounter. Shock (60 Hz) was applied to alternate grids from an autotransformer through a 10,000-ohm resistor.

Procedure

All Ss were handled for 4 days after being placed in individual cages. On the fifth day they were allowed to explore the runway and goalbox for 10 min. They were then randomly divided into four groups, to be given 0-, 35-, 45-, or 55-V shocks in the runway. All Ss were given one trial per day, with a different random order for running the Ss each day. They were given 3 days with a habituation trial (no shock) followed by 4 days of escape-training trials on which they received runway shock of an appropriate intensity for the group.

A trial consisted of placement in the chamber over the startbox, where the activity level of the animal was monitored for 10 sec. After the 10 sec, the trap-door floor of the chamber was released, dropping the animal onto the electrified grid at the start end of the runway. After the animal had escaped from the runway to the nonelectrified goalbox, it remained there for 30 sec before being returned to a carrying cage.

RESULTS

Because of large individual differences in activity level, an activity-suppression ratio was calculated by comparing the median activity level on the three habituation trials with the median of the last three escape-training trials according to the equation: (hab-acq)/(hab). A plot of the mean suppression ratio as a function of shock level is presented in Fig. 1. Activity declined in all groups, the magnitude of the suppression being a monotonic function of shock level. A one-factor analysis of variance indicated that the treatment effect was significant ($F = 5.33$, $df = 3/28$, $p < .005$). A Newman-Keuls test for stepwise comparisons indicated that each of the shock groups differed significantly from the no-shock control group. The correlation between shock level and suppression ratio was highly significant ($r = .596$, $t = 4.07$, $df = 30$, $p < .001$).

DISCUSSION

The significant suppression of activity and the high correlation between that suppression and the level of shock are both strongly supportive of the suggestion that freezing or crouching can be used as a reliable index of fear. Also supported is the suggestion that such freezing can be successfully detected with the measurement technique used in this experiment. The possibility of indexing the degree of fear during a period immediately before a trial suggests the potential utility of this technique in studies of other more complex fear-motivated behaviors.

One unexpected phenomenon was the rather large decline in activity in the no-shock animals. While this could be due to the extinction of exploratory responses or the slight buildup of fear because of the undoubtedly noxious trap-door-dropping procedure, results of other studies indicate that so rapid a

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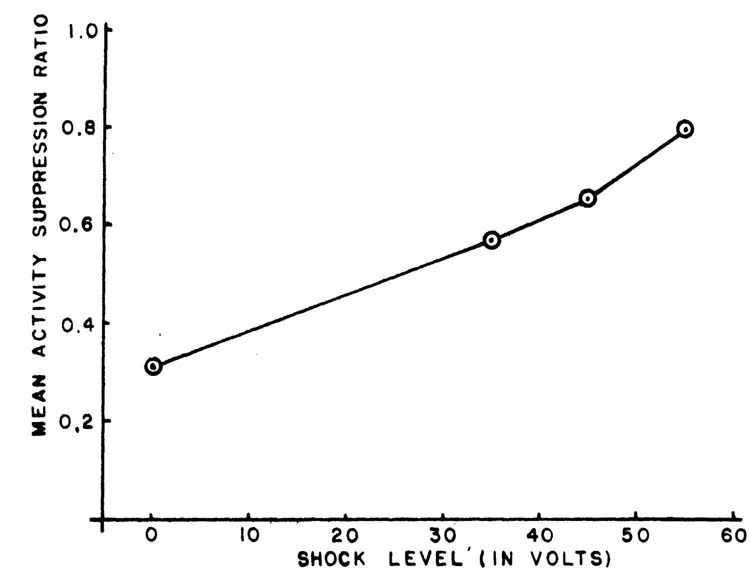

Fig. 1. Mean activity suppression ratios for all groups as a function of shock intensity.

decline in activity is not likely due to those processes alone. There is also the possibility that the intermixing of shock and no-shock animals in the random sequence of running each day could supply the no-shock animals with alarm pheremone cues from the shocked animals in a manner similar to that reported by Courtney, Reid, & Wasden (1968). This important possibility is currently being explored.

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Activity level and secondary motivation: Frustration

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Three groups of hooded rats were given 15 placements to either continuous reward, alternating partial reward, or nonreward in a box where activity level was monitored. In acquisition, nonrewarded animals appeared more active than continuously rewarded animals, with partially rewarded animals showing activity levels similar to the group matching their reward type on that trial. In extinction, the continuously rewarded Ss' activity rose to a level significantly above both the nonrewarded and partially rewarded groups, consistent with predictions of frustration-induced arousal and activity.

Following a review of 20 years of research on the double runway frustration effect (e.g., Amsel & Roussel, 1952), Scull (1973) concludes that the major impact of that research is not a conclusive judgment on frustration theory, but rather a pointing out that "the double runway is a much more complex situation than anticipated." Scull lists a number of conceptions, in addition to frustration theory, which have been generated, some introduced to supplement that theory, others expressed as competitive alternatives. A number of situations somewhat simpler than the double runway are also discussed, with the data from these less complex situations often providing the more useful and unambiguous information about frustration and related notions.

Among the simplest situations mentioned were those in which an increase in general activity level was observed following a reduction or removal of reward. These studies have involved either open-field activity measures following runway trials (Gallup & Altomari, 1969; Gallup & Hare, 1969; Tacker & Way, 1968; Topping, Cole, Matamores & Linenberger, 1970), or