Susceptibility of an instrumental locomotor response to punishment of its generalized consummatory components: Effect of punishment locus

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Following the establishment of strong approach behavior in a double runway, the generalized consummatory components (approach and licking) of this behavior were punished in a similar context by either a single contingent paw shock or by a single tongue shock. When retested in the runway the next day, a nonshocked control group showed an increase, while both shocked groups showed a decrease in speed in all segments of the double runway. The suppression effect was greatest in the goal areas and least in the start areas. Paw shock had a greater suppressive effect than tongue shock. An implication for the study of the energizing function of fear was suggested. Albino rats served as the experimental Ss.

Fowler (1963) has reported that punishment of the consummatory response at the end of a straight runway facilitated instrumental response acquisition in rats whose initial response to the shock was to move forward, but depressed acquisition in rats whose initial response was to back away from the shock. Martin & Ross (1964) found that the running response was facilitated both in acquisition and in extinction when the consummatory response was punished on 50% of the trials and when shock was introduced in gradual intensity increments. The primary purpose of the present experiment was to explore any changes which might occur in an instrumental locomotor response as a result of punishment of its consummatory components in their generalized form. To this end, a response was established and tested in Context A, then its goal aspects were punished in a similar context, B. Since the present authors had demonstrated earlier the influence of locus of application of punishment (Braud & Prytula, 1969), a secondary purpose was an examination of any differential effects of tongue vs paw shock as the punishing event.

Finally, an instrumental response (running a double runway) was selected which permitted a test of the hypothesis that the same environmental event may have either facilitative or suppressive effects, depending upon the temporal relationship between that event and the indicant response.

SUBJECTS

The Ss were 18 male albino rats of the Cheek-Houston strain which were 80-90 days old at the beginning of training. The Ss were caged individually and were maintained at approximately 80% of their initial ad lib body weight throughout the experiment. Water was available continuously in the home cage.

APPARATUS

Two experimental spaces were used in the experiment. The first was a wooden straight double runway, 4 in. wide and 6¼ in. high. The lengths of its components were as follows: Start Segment 1, 9 in.; Run Segment 1, 23.5 in.; Goal Segment 1, 12.5 in.; Start Segment 2, 10.5 in.; Run Segment 2, 36 in.; Goal Segment 2, 12 in. The walls of the first runway were painted grey, the second runway black. The entire apparatus was floored with ¼-in. hardware cloth, and was covered with hinged, clear Plexiglas lids. Aluminum spoon goal cups were attached to the left walls of the goal areas. Guillotine doors prevented egress from all start and goal boxes. Locomotion times were recorded by a system of photocells, relays, and electric timers.

The second experimental space consisted of two unpainted wooden compartments, 13 x 3½ x 6¼ in. i.d. These compartments were covered by hinged, clear plastic tops; the floors consisted of 1/8-in. stainless steel grid bars spaced ¼ in. center to center. One end wall of each box was clear Plexiglas, the other wood. Goal cups (aluminum teaspoons) were located at the left walls of the respective compartments, 2 in. from the wooden end walls and 1¾ in. above the floors. The goal cups and the grid floors could be independently electrified by a fused, variable voltage autotransformer through a 10K fixed series resistor.

PROCEDURE

The Ss were trained, in the first apparatus, to run to the goal cups and lick their respective contents, which consisted of 0.25 cc of a 16% (by weight) sucrose-distilled water solution. The Ss were given five trials per day for 6 days; they were run in squads of six animals, with an intertrial interval of approximately 5 min. The Ss were given their daily ration of Wayne Lab Chow (varied in quantity so as to maintain Ss at appropriate body weights) 1 h after their last daily trial.

On Day 7, the Ss were divided randomly into three groups of six Ss each. The Ss of the paw-shock group were placed in the second (punishment) apparatus and were allowed to approach and lick the 0.25-cc sucrose solution in the goal cup. Contact with the metal goal cup resulted in the delivery of shock to S's paws. The Ss of the tongue-shock group were treated similarly, but shock was now delivered to the tongue rather than to the paws of the S. The Ss of the no-shock control group were placed in the apparatus and allowed to lick, but shock was never administered. In all cases, the shock was 75-V ac delivered through a 10K resistor. Shock duration was determined by the S's time in contact with the goal cup (drinkometer controlled). The Ss were run in the punishment apparatus in a random sequence, with an intertrial interval of approximately 15 min.

On Day 8, all Ss were given five additional double-runway trials, under conditions identical to those in effect on Days 1-6. The E who ran the Ss through their final runway trials was unaware of the Ss' group membership.

RESULTS

All locomotion times were converted into speed scores (inches/second). Figure 1 presents mean speeds for the three groups in each of the six runway segments. The preshock scores were based upon the Ss' speeds on the final (30th) preshock trial; postshock scores were based only upon the very first trial following shock. This first postshock trial provided a test of possible suppressive or facilitative effects uncontaminated by exposure to aversive stimuli in the double runway itself. The absence of such exposure minimized possible extinction effects, and was most important in providing an adequate test of any facilitative effects, in the early segments of the second runway, of just having experienced an aversive event in the first goal box.

As can be seen in Fig. 1, the Ss of both shock groups showed a speed decrement on the postshock trial in every segment of the double runway. This speed decrement is greater for paw-shock than for tongue-shock Ss. The nonshocked control Ss, on the other hand, showed a speed increment in all segments except the second goal segment. Since the three groups were performing at different levels on the preshock trial, an appropriate assessment of the effects of the shock treatment involved a rate-of-change measure, rather than an absolute speed score on the postshock trial. Differential pre-post speed changes (slopes) are indicated by a

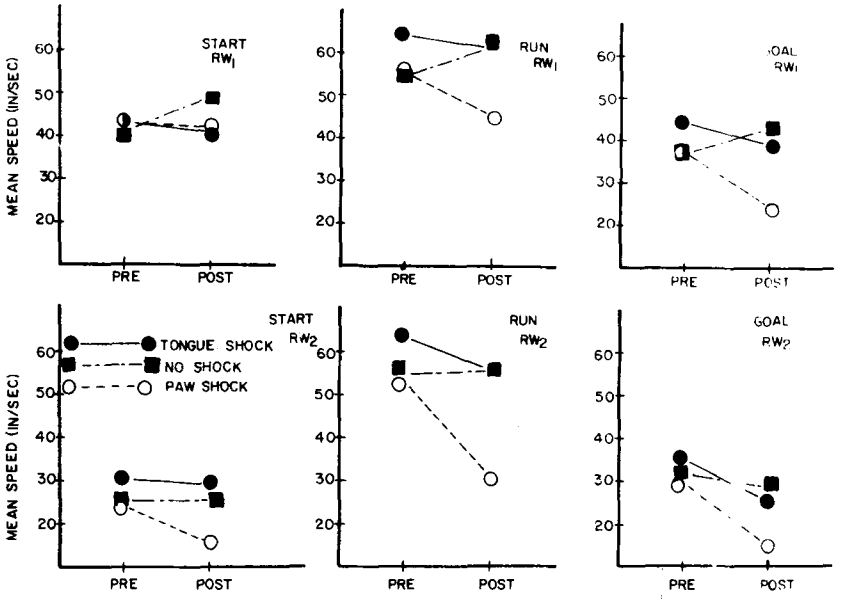

Fig. 1. Mean running speed in each of the six double-runway segments, for Ss experiencing paw shock, tongue shock, or no shock in a similar apparatus.

significant Days by Groups interaction effect in a Lindquist Type 1 analysis of variance (Lindquist, 1953). Such an analysis was performed on the data of each of the six segments. The groups effect (shock conditions) was significant for all measures (dfs = 2/15, ps $< .05$) except for Runway 1 start speeds; the days effect (preshock vs postshock trials) was significant in the case of the second runway run ($F = 9.49$, $df = 1/15$, $p < .001$) and goal ($F = 21.26$, $df = 1/15$, $p < .001$) speeds; the Days by Groups interaction effect was significant for running speed in the second runway ($F = 4.87$, $df = 2/15$, $p < .05$). For all other measures, except start speed in the first runway, the interaction effect fell just short of the .05 significance level (dfs = 2/15, ps $< .10$).

DISCUSSION

This study demonstrates a striking and consistent effect upon an instrumental locomotor response of the punishment in its generalized consummatory components by a single electric shock administered in another context. Such punishment depresses performance in all parts of the locomotor chain, overcoming the "reminiscence" increment seen in the nonpunished control group. As was found in a previous study (Braud & Prytula, 1969), locus of shock application is an important variable, with paw shock producing a greater decrement than tongue shock.

Approach and licking behaviors were punished in the presence of cues similar to those existing in the double runway goal boxes. The importance of this similarity is indicated by the speed decrement gradients observed in both alleys. The negative slope (reduction in speed) is greatest in the goal regions (areas of maximal similarity to the punishment situation) and is relatively slight in the start regions (minimal similarity). Note also that the effect of tongue shock falls off much more rapidly, with increasing distance from the goal, than that of paw shock.

The punishment effect appears to be specific for locomotion. No shocked animal failed to immediately consume the goal cup contents on every postshock double runway trial. Nor could the E, who was unaware of the Ss' group membership, detect any gross behavioral changes which might have allowed him to predict whether a given S had been shocked or not.

It was hypothesized that shocking the Ss in the presence of cues similar to those of the goal boxes would result in the elicitation of a generalized fear reaction in those goal boxes. Responses immediately preceding this aversive reaction (i.e., run and goal speeds in the first runway) should be punished, while responses occurring in the presence of the aversive reaction (start speed in the second runway) should be facilitated. The predicted increase in second runway start speed for the shocked Ss was not observed in the present study. The obtained results favor a simple associative process whereby responses are suppressed in the presence of stimuli accompanying the presentation of an aversive stimulus.

It may be the case, however, that fear does energize ongoing behavior, but that such an effect was not observed in the present experiment due to the nonoccurrence of fear in the double runway apparatus. Stimulus similarity may have been great enough to mediate instrumental response suppression, but may have been insufficient to produce a generalized fear reaction in the first goal box. Some indirect support for this suggestion is the finding (Hoffman & Fleshler, 1965) that a very weak aversive stimulus may suppress an instrumental response when its presentation is response-contingent, but the very same weak stimulus does not appear adequate to produce a generalized emotional reaction, fear. The possibility of such a dissociation of specific associative and generalized motivational effects of the same aversive stimulus may have important implications for any tests of the energizing function of fear.

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