Persistence and vigor of shock-induced aggression in gerbils (*Meriones unguiculatus*)*

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Following a 2-h preshock observation period, each of two pairs of male gerbils (*Meriones unguiculatus*) experienced footshocks every 20 sec for a 3-h period, which was followed by a 1-h postshock period. Bites, forepaw strikes, and poses were recorded for the 6-h session. In contrast to rats and other rodents, pain-shock produced biting and striking, which persisted throughout the interval between shocks and induced aggression of sufficient vigor to produce bleeding in all four Ss. Biting, striking, and posing also persisted throughout a 1-h postshock period, but at a decreasing rate relative to the shock period rate. The gerbil would thus appear to be a unique rodent—one whose vigorous fighting baseline should be useful in studying the interaction of aggression with escape-avoidance, anaggressive drugs, brain lesions, and other factors.

A variety of paired experimental animals display reflexive fighting elicited by pain-shock—for example, mice (Tedeschi et al, 1959), hamsters (Ulrich & Azrin, 1962), rats (Ulrich & Azrin, 1962), and squirrel monkeys (Azrin, Hutchinson, & Hake, 1963). Perhaps the most thorough experimental analysis of pain-aggression has been carried out for rats, with fighting being influenced by such factors as shock intensity, duration, and frequency, as well as chamber size (reviews of this work are in Ulrich, 1967; Ulrich & Symannek, 1969).

With rats, shock-induced fighting typically does not last for more than 1 sec beyond shock termination and the fighting is not of sufficient intensity to produce physical injury (Ulrich & Azrin, 1962). Squirrel monkeys, in contrast, typically fight for long periods of time after shock termination and with sufficient vigor to inflict physical injury (Azrin, Hutchinson, & Hake, 1963). An incidental observation of extremely vigorous fighting in our laboratory gerbils suggested that the gerbil might differ from most other rodents with respect to shock-induced aggression.

SUBJECTS

The Ss were four male gerbils (*Meriones unguiculatus*) that had been purchased from Tumblebrook Farms, Inc., and had served as controls in an earlier study (Dunstone, Krupski, & Weiss, 1971); they were approximately 270 days old at the time of the present study and had been maintained on free food and water in individual cages since 90 days of age.

*This research was supported in part by NSF Grant GY-8992. Reprints may be obtained from Dr. John J. Dunstone, Dept. of Psychology, University of Scranton, Scranton, Pa. 18510.

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APPARATUS

Pain-aggression was observed in a 10.5-in.-high Lehigh Valley Electronics (LVE) Model 1417 test chamber within a Model 1417c sound-insulated cubicle in which white noise was present. A wooden wall, inserted parallel to the floor shock rods, was used to reduce chamber floor area to 5.5 x 9.5 in.—a large area for gerbils in comparison to the optimal floor area reported for fighting in the larger white rat (Ulrich & Azrin, 1962). Scrambled shock was delivered to floor rods by LVE Model 1531 shocker and Model 1311ss shock scrambler. Shock delivery was controlled by LVE solid-state and electromechanical modules. Onset and offset responses were recorded by using the channels of a Gilson M5P polygraph as event indicators. Paper speed was 10 mm/sec.

PROCEDURE

Response Definition

Three aspects of aggression were measured. When either member of a gerbil pair assumed the stereotyped fighting pose described by Ulrich & Azrin (1962), a microswitch was depressed for the duration of the pose. Separate poses were scored only when separated by at least 1 sec. Pose duration was measured by converting paper length in millimeters into seconds.

A microswitch was also depressed when either gerbil made striking movements of the forepaws directed at the second S. Since these very rapid motions typically occurred in a long-duration series, separate strikes were scored only for bursts separated by at least 1 sec. The duration of such strikes was also measured. No requirement was made that a strike be scored only in the presence of posing, since striking often occurred while Ss were rapidly running within the experimental chamber.

Biting by either member of a pair did not occur in a series of long duration; thus, a microswitch was depressed when either member of a pair attempted to bite the other member. Since bites were very rapid motions of short duration, no attempt was made to measure their duration.

Separate Os recorded each of the three response measures. Reliability

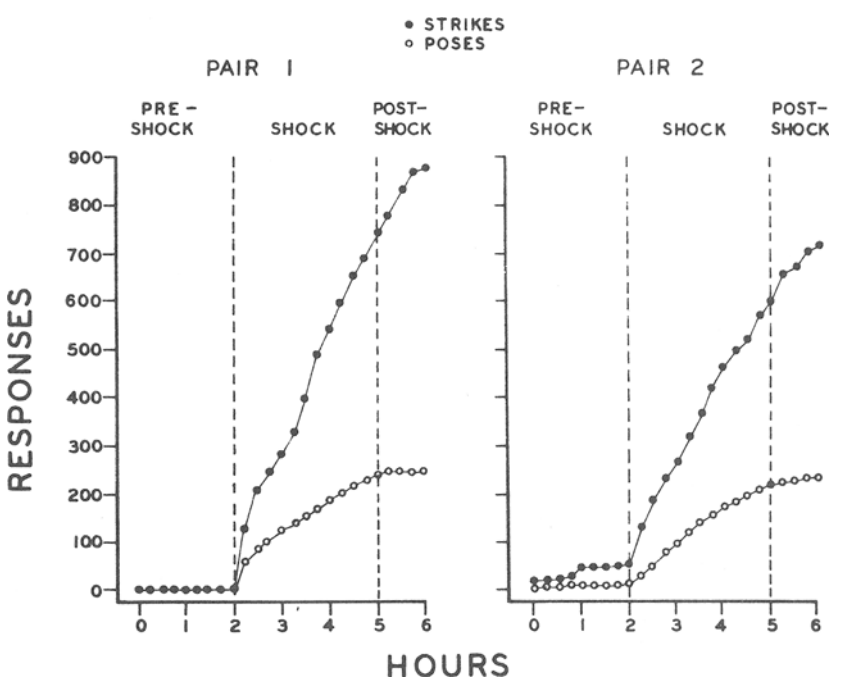

Fig. 1. Cumulative poses and strikes per 15-min intervals for Pair 1 and Pair 2.

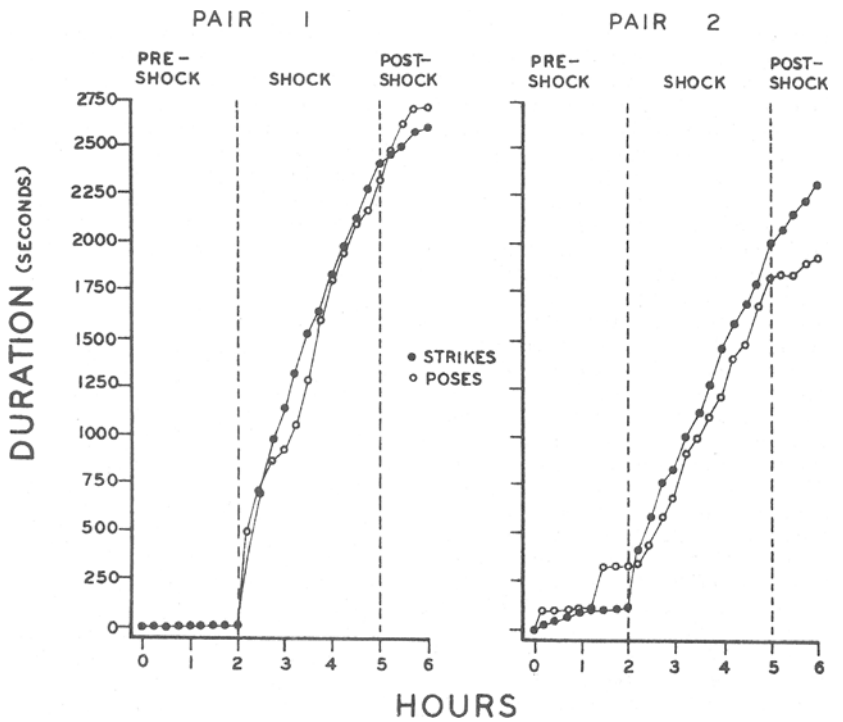

Fig. 2. Cumulative pose and strike durations per 15-min intervals for Pair 1 and Pair 2.

checks between the experiment's Os indicated 96% agreement for poses, 95% agreement for strikes, and 92% agreement for bites.

Shock Presentation

Poses, strikes, and bites were recorded for a 6-h period. Following a 2-h preshock period, footshocks of 3-mA intensity and .5-sec duration were presented every 20 sec for a 3-h period (531 shocks/3 h). The experiment was terminated following a 1-h postshock period because of bleeding observed in Ss.

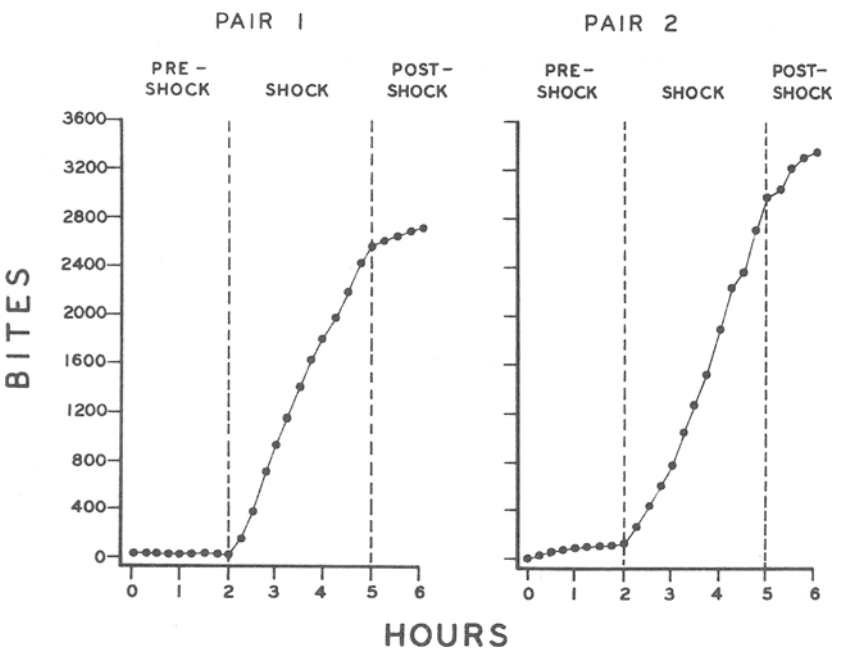

Fig. 3. Cumulative bites per 15-min intervals for Pair 1 and Pair 2.

RESULTS AND DISCUSSION

Pain-shock elicited aggression in gerbils that was both quantitatively and qualitatively different from shock-induced aggression reported in rats and other rodents (Ulrich & Azrin, 1962). Figure 1 shows cumulative strikes and poses per 15-min periods for each pair of Ss over the 6-h session. Unlike rats, both pairs of gerbils continued to pose and engage in striking movements during the postshock period, with a great decrease in pose rate relative to the shock period and with a somewhat smaller relative decrease in strike rate.

During the 2-h preshock period, Pair 1 displayed no strikes or poses and Pair 2 displayed few relative to the shock period. With the delivery of the first shock, both pairs of Ss immediately assumed the stereotyped fighting pose and engaged in many rapid striking movements of the forepaws. Many subsequent shocks did not elicit posing but, rather, produced rapid escape-like running during which Ss engaged in striking and/or biting—a qualitatively different finding compared to shock-induced rat aggression. In addition, many shocks produced more than one discrete burst of striking movements; the 531 shocks produced 740 strikes in Pair 1 and 537 in Pair 2.

The rate of posing and of striking decreased during the 3-h shock period, with poses showing a relatively greater decrease for both Pair 1 and Pair 2.

Figure 2 shows cumulative time spent in posing and in striking per 15-min periods for each pair of Ss over the 6-h session. While the duration of poses and of strikes slowly decreased over the shock period, a relatively larger decrease occurred in the postshock period.

It should be noted that the decrease in pose duration during the postshock period, relative to the shock period, was not nearly as great as was the decrease in pose rate (cumulative number of poses/time), thus indicating that Ss spent more time in uninterrupted posing during the postshock period. Pain-shock onset often did interrupt poses during the shock period, producing escape-like jumping and running accompanied by striking and/or biting. Thus, mean pose time (total time posing/number of poses) increased from the shock to the postshock period for both pairs of Ss, with the means for Pair 1 increasing from 9.6 sec to 36.6 sec and the means for Pair 2 increasing from 7.4 sec to 9.8 sec.

While Ulrich & Azrin (1962) reported that rats typically struck at each other for less than 1 sec, mean time striking (total time striking/number of strikes) during the

shock period was 3.2 sec for Pair 1 and 3.5 sec for Pair 2, thus indicating a quantitative difference between rats and gerbils in shock-induced aggression. In addition, rats and other rodents seldom fight during the interval between shocks, while our gerbils, in contrast, engaged in much striking and/or biting between shock presentations.

The persistence of striking (and of biting) throughout the intervals between shocks may be illustrated by an examination of the percentage of intervals in which at least one bit (and one strike) occurred in the last 4 sec before shock onset. For successive quarters of the 3-h shock period, bites occurred for Pair 1 in 45%, 33%, 31%, and 22% of the 4-sec intervals; these values were 33%, 27%, 33%, and 26% for Pair 2. Strikes occurred in 55%, 35%, 38%, and 24% of the 4-sec intervals for Pair 1, and in 39%, 24%, 29%, and 24% for Pair 2. Thus, while both pairs of Ss showed biting and striking in successive quarters of the 3-h shock period, the frequency of these responses generally decreased from the first to the last quarter—perhaps due to the debilitating effects of shock-induced aggression on Ss.

Figure 3 shows cumulative number of bites per 15-min periods for each pair of Ss. Biting occurred throughout many of the intervals between shocks, with the 531 pain-shocks producing 2,543 bites for Pair 1 and 2,865 bites for Pair 2—considerably more biting than reported for rats (Ulrich & Azrin, 1962). The great decrease in bite rate during the postshock period would seem to indicate that much of the biting observed during the shock period was initially produced by pain-shock.

It might also be noted that all Ss were bleeding considerably from the head and neck after 6 h, necessitating a termination of the postshock period. Bleeding is seldom reported for rats (Ulrich & Azrin, 1962).

Fight Probability

A fight was defined when one or both members of a gerbil pair bit or struck at the other. Fight probability (number of shocks eliciting at least one fight/total number of shocks) was determined for the 2-sec interval following each shock onset and for the entire 20-sec interval between shock onsets. Fight probability for the 2-sec interval was .73 for Pair 1 and .71 for Pair 2. These probabilities increased to .75 for Pair 1 and .73 for Pair 2 when the entire interval between shocks was considered—values similar to those reported for rats receiving 2 shocks/min (Ulrich & Azrin, 1962).

The finding that all but 2% of fights began within 2 sec of pain-shock indicates that fighting, when it did occur, was initially elicited by pain-shock and that aggression apparently acted as its own stimulus in maintaining continued fighting throughout the intervals between shocks.

CONCLUSION

In contrast to rats andother rodents, pain-shock in gerbils produces vigorous striking and biting, which persists throughout the interval between shocks and which also persists after the removal of all shock. The gerbil, because of its large fighting baseline, would thus seem to be a suitable animal for use in studies dealing with such topics as anaggressive drugs and the interaction of aggression with escape avoidance and other processes.[1] It should be noted, moreover, that the gerbil is perhaps less "domesticated" than other laboratory rodents—a factor which could account for the large amount of shock-induced aggression observed in the present study, and which might also be investigated with other less domesticated rodents.

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NOTE

1. In preliminary work, paired gerbils that had been housed together did not display either the persistence or the vigor of striking/biting found in the present study. Social influences on pain-induced aggression are currently under study.