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ELICITATION AND PUNISHMENT OF INTRASPECIES AGGRESSION BY THE SAME STIMULUS[1]

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Fighting responses were elicited in pairs of rats by shocks over a period of 46 days. During certain blocks of these days, "punishing" shocks were made contingent on the shock-elicited fights. Fighting frequency was reduced as a direct function of the intensity of the contingent shocks. Fighting frequency recovered completely when contingent shocks were removed.

A substantial literature has developed in the area of elicited (usually shock-elicited) aggression, with increasing emphasis on a laboratory analysis of the parameters of this effect. Summaries of much of this work can be found in Ulrich, Hutchinson, and Azrin (1964) and in Ulrich (1966). Recent research seems increasingly concerned with variables that might preclude aggressive responses to shock. Roberts and Larson (1967) showed substantial reduction of shock-elicited aggression in pairs of rats following adaptation to the shock chamber and to each other, and Ulrich and Craine (1964) showed that a discriminated avoidance response would compete with and, thus, reduce shock-elicited fighting. In addition, there has been a short series of experiments by Baenninger and others (*e.g.*, Myer and Baenninger, 1966) showing that mouse-killing by rats can be suppressed by contingent punishment. Finally, two experiments have been reported by Ulrich, Wolfe, and Dulaney (1969), and Baenninger and Grossman (1969) that demonstrate, respectively, the suppression of shock-induced hose-biting in monkeys by contingent shock and the suppression of tail-pinch elicited aggression in pairs of rats by contingent shock.

The results of the present experiment extend these findings by showing that: (1) intraspecies shock-contingent fighting is suppressible by fight-contingent shock; (2) probability of fighting varies inversely with the intensity of fight-contingent shock.

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METHOD

Subjects

Thirty naive, male albino rats (Sprague-Dawley), 75 days old at the beginning of experimentation, were maintained on a free-feeding regimen throughout.

Apparatus

All of the rats were run throughout the experiment in a 10.5 by 12 by 9.5 in. (26.7 by 30.5 by 24 cm) Lehigh Valley Electronics Model 1417 Chamber. Grason-Stadler Model E164GS shock generators provided the eliciting and punishing shocks. The usual relay support apparatus scheduled the eliciting shocks.

Procedure

The experiment lasted 46 days and was divided into four phases. At the beginning of Phase I, which lasted 20 days, the 30 rats were randomly paired. Pairs remained the same throughout experimentation. During Phase I, each of the 15 pairs of rats was given two-hundred 2-mA foot shocks of 0.5-sec duration during a daily 10-min session—a rate of 20 shocks per minute, one every 3 sec (*cf.* Ulrich and Azrin, 1962)—during which fighting responses were counted. The 15 pairs were then assigned to three five-pair treatment groups that were matched on the basis of fighting frequency over Phase I. These groupings remained constant throughout the balance of the experiment. Phase II, the first punishment period, lasted 10 days. During these 10 sessions, the pairs of Group C, the control, continued to receive only the 0.5-sec time-dependent

(eliciting) shocks; the pairs in Groups E2 and E4 received, in addition, a 0.5-sec 2- or 4-mA foot shock immediately contingent upon each shock-elicited fight. The punishing shock was provided via a hand switch by the experimenter, who pressed the switch as quickly as possible upon observing an elicited fight. With the onset of the punishment shock, the eliciting shock was terminated, so that the total shock time consisted of the 0.5 sec of punishment plus the time required for the experimenter to observe an instance of elicited aggression and then punish it. Phase III was, like Phase I, a period during which no punishment was contingent on elicited aggression and lasted 11 days. Phase IV, which lasted five days, returned Groups E2 and E4 to the punishment condition, but reversed the shock values of punishment for the two groups. E4 now received the 2-mA contingent shock and E2, the 4-mA one. Group C pairs continued to receive only time-dependent shocks.

No control was included specifically for shock-frequency increase due to fight-contingent shocks, since Ulrich and Azrin (1962) have shown that, in rats, the number of fights is a linear function of number of shocks within the limit of the maximal number of shocks rats could receive in the present experiment. Thus, any decrement in fighting would not be due to an increase in shock frequency *per se,* but to the contingency.

The defining criteria of aggressive behavior were three: (1) Both subjects standing on the hind feet with front feet extended and heads raised (Ulrich and Azrin, 1962); (2) a similar position with the animals biting at each other or scratching at each other with the front feet; (3) one subject lying on its back with the other rat above it scratching or biting the supine rat (*cf.* Baenninger and Grossman, 1969). These criteria were agreed upon after both authors had practised observing elicited aggression. Subsequently, if a pair of rats exhibited any one of these sets of behavior, an aggressive response was scored. All pairs of rats were run throughout the experiment by the second author. The first author "sampled" pairs from time to time to check for shifting criteria. Such checks revealed a disagreement of only 2% to 4% of instances of recorded fighting. The backs of all rats were shaved every 3 to 4 days to eliminate shock reduction through insulating hair.

RESULTS AND DISCUSSION

Figure 1 shows mean probability of fighting (number of fighting responses per 200 shocks divided by 200) for each daily session for the three treatment groups. Clearly, shock-elicited fighting was reduced as a direct function of the intensity of the punishing shocks in Phase II, the first punishment phase. A treatment-x-sessions analysis of variance for the 10 punishment sessions of Phase II yielded a between-intensities F of 39.59 (6.93 needed for significance at the 0.01 level for $df = 2/12$). Figure 1 also shows that a sharp decrease in fighting occurred for both punishment groups for the first punishment session, both groups dropping from fighting probabilities of 0.32 and 0.34 for Session 20, to 0.18 and 0.16 for Session 21. Separation of the fighting probabilities of the two groups did not occur until Session 26, whereafter it appears that E2's fighting frequency was recovering, even with punishment still in effect, and E4's was not. Every pair in Group E4 fought less during the second five sessions than they did during the first five sessions of Phase II, and every pair in Group II showed recovery during these second five sessions except pair E2D, which showed no trend. Therefore, the possibility that, at certain levels of punishment, elicited aggression may recover in frequency even while punishment is still in effect may be worth pursuing (*cf.* Azrin, 1960).

Figure 1 shows that by the end of Phase III, the groups had returned to roughly common fighting frequencies (between-groups $F < 1.0$). Then, during the five days of Phase IV, wherein contingent-shock intensities were reversed for Groups E2 and E4, elicited fighting was again reduced as a direct function of the contingent-shock intensities. An analysis of variance of difference scores for Groups E2 and E4 produced a between-treatments F of 6.38 (5.32 needed for significance at the 0.05 level for $df = 1/8$). Thus, degree of fighting reduction, on the average, followed the intensity reversal, as the Phase IV data points in Fig. 1 indicate. A difference score is the mean fighting probability for the last five sessions of Phase III baseline minus fighting probability during each Phase IV session for each pair. Difference scores were used in this analysis because it seemed the simplest way to take into account the actual, though statistically non-

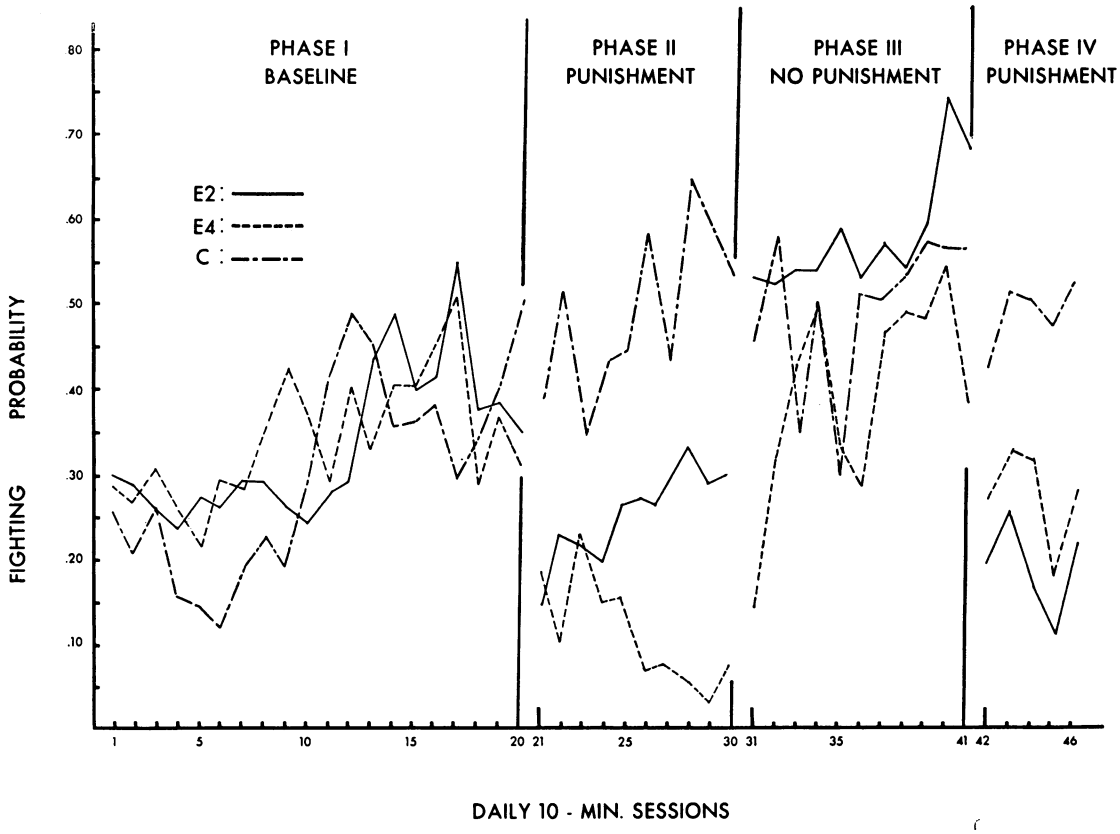

Fig. 1. Mean probability of elicited fighting in pairs of rats for forty-six 200-shock sessions under punishment and no-punishment conditions.

significant differences among the groups during the last five sessions of Phase III.

A comparison of each pair of rats with itself over the four phases of the experiment yields not quite so satisfying a picture. All E2 pairs (those first punished with 2-mA shocks) showed greater absolute drops from their baseline fighting frequencies by factors of 1.6 to 3.0 when subsequently punished with 4-mA shocks than when punished with 2 mA. These drops are the differences between the mean fighting frequencies for the last five sessions of a given baseline phase and the first five sessions of the following punishment phase. On the other hand, only two of the pairs in Group E4 showed greater drops in fighting when punished with 4-mA shocks than when subsequently punished with 2 mA, whereas two other pairs showed the reverse, and one pair showed no differential effect. Whether this inconsistency is some sort of crude reflection of an order effect, or arose from imperfect control or an insufficient number of Phase IV sessions for effects to develop, is not determinable from the data.

Three things should be noted. First, in Phase III, elicited fighting, markedly reduced by punishment in Phase II, gained the baseline that had been reached by the non-punished control animals. On the assumption that fighting would not be permanently suppressed by the values of punishment used during Phase II, such a return is predictable in terms of the age of the subjects and shock history of the subjects (*cf.* Hutchinson, Ulrich, and Azrin, 1965; Roberts and Larson, 1967). Second, during punishment sessions, the pairs of rats engaged in fewer fighting episodes but appeared to be more vigorous, to make more contacts, and attack *movements* during an episode than they did in non-punishment sessions. Moreover, the punishing shocks elicited a slight continuation of fighting once an eliciting shock had induced a fight. This was largely due to the fact that rats typically fought for as long as shock was present (but no longer),

once aggressive behavior was elicited. Since punishment of elicited fighting prolonged the shock from 0.5 sec to 0.5 sec plus the time the eliciting shock was on before the experimenter pressed the hand switch (typically 0.3 to 0.4 sec), aggressive behavior was lengthened by this amount as well. Such slight prolongations were not, in turn, punished. It is conceivable therefore, that total duration of fighting could have been longer during punishment phases than during non-punishment phases. But the punishing shocks reduced the probability of the time-dependent shock evoking a fighting episode to begin with. Since the punishing shock did this, there were fewer episodes in which fighting could be prolonged, *e.g.*, eight episodes on Day 29 for group E4 as compared with about 130 for the control on that day. Thus, total fighting time was reduced by punishment.

Third, since the present data were collected, Azrin (1970) reported findings with which our data are entirely consistent. Azrin induced hose biting in squirrel monkeys by time-dependent shocks and also punished such elicited biting with shocks. He varied the intensity of the punishing shock through four intensities. Hose biting was inversely related to the intensity of the punishing shocks. Taken together, the Azrin study and the present one provide some generality for this inverse relation for species and aggressive measure.

Finally, it is worth stressing that elicited fighting shows the same kind of suppression by and recovery from punishing contingent events that free operants such as lever pressing do, even though such fighting has some respondent characteristics and is usually called "reflexive". Such data as the present findings indicate that elicited fighting is certainly affected by its consequences. These data, therefore, call into question not only the utility of considering such fighting "reflexive", but also the tendency to consider elicited behavior, in contrast to emitted behavior, as independent of its consequences.

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