EFFECT OF SHOCK DURATION ON SHOCK-INDUCED FIGHTING¹

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Shock-induced fighting between paired rats was a direct function of the duration of the shock stimulus. Continued presentations of the shock partially reversed this direct relationship.

Previous research has disclosed that fighting will be produced between a pair of rats upon delivery of a brief and painful foot-shock (Ulrich and Azrin, 1962). The present study attempts to ascertain whether the elicitation of fighting is a function of the duration of the shock deliveries.

METHOD

Subjects

Twelve Holtzman male rats about 120 days of age were used as Ss in this study because of the low incidence of fighting in the absence of shock. A second advantage to the use of rats was the mildness of the fighting episode. Monkeys, for example, have been found to physically injure each other during the attack that followed the delivery of pain-shock, making it difficult to obtain repeated measurement of the fighting from the same subjects (Azrin, Hutchinson, and Hake, in press).

The definition of fighting in the present study was the same as that used in a previous study (Ulrich and Azrin, 1962), which may be referred to for further details. Briefly, the observer(s) depressed a microswitch (indicating that a single fighting response had been made) when one or both rats lunged or struck at the other, producing physical contact. When one rat lunged or struck at the other, the attacked rat usually struck back at the

aggressor. Two observers were used during the experiment; 97% agreement between observers was obtained regarding the occurrence or non-occurrence of a fighting response.

Apparatus

The chamber, the same as that used in the previous study, measured 12 by 10 by 8 in. and had a grid floor through which foot-shock could be delivered. The sides and top of the chamber were transparent, allowing unrestricted observation of the Ss. The chamber was in a sound-attenuating enclosure. Responses were recorded on counters and on an Esterline-Angus recorder in a separate room.

Shock was delivered to the floor grid at an intensity of 2 ma from an Applegate constant current stimulator through a polarity scrambling circuit of the type devised by Hoffman (1962).

Prior to the experiment, Ss were divided into six pairs and exposed to various durations of shock delivery over a period of several days to allow possible adaptation to the experimental situation. Following this initial exposure, the experiment proper was instituted. Each pair of Ss was exposed to 200 shocks each day. The shocks were delivered 3 sec apart as timed from the end of one shock to the beginning of the next shock. The shocks were a specified duration on a given day. The shock durations used were .075, .12, .2, .5, 1.5, and 3.0 sec. A control period was also conducted in which no shock was delivered (0.0 sec). The sequence of shock durations was counter-balanced and differed for each pair of Ss. The entire series of six durations was administered twice. Thus, each pair of Ss was given a total of 2400 shocks during 12 experimental sessions (200 shocks per session).

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RESULTS

Figure 1 shows how the various durations of shock affected the probability of occurrence of a fighting response. Probability of fighting is taken as the number of fighting responses divided by the number of shocks delivered. A ratio of 1.00 means that a fighting response was elicited by every shock. The function of Fig. 1 is the average of the six pairs of Ss for the first 20 shock deliveries that were given each day. The longer the duration of the shock, the greater was the likelihood of eliciting a fighting response. It can be seen that no fighting responses occurred in the absence of shock (0 sec). At .075 sec, about one-fourth of the shocks elicited fighting. At .5 sec duration, 90% of the shocks elicited fighting. At 3.0 sec, the longest duration used, fighting occurred after almost every shock (97%). Although Fig. 1 is based on the average of six pairs of Ss, the same monotonic function describes the reactions of each of the pairs of Ss. The major discrepancy between the individual functions and the group function was the failure of one pair of Ss to fight at the briefest shock duration of .075 sec.

Figure 2 shows the probability of fighting as a function of continued shock presentation during the daily series of 200 shocks (Fig. 1

Fig. 1. Probability of obtaining a fighting response between a pair of rats following the delivery of foot-shocks of different durations. The curve is for the first 20 shocks delivered during each session and is an average for six pairs of rats.

Fig. 2. For each duration of shock, the probability of fighting between paired rats is presented as a function of successive blocks of 40 shocks. The curves are based on the average score for six pairs of rats.

dealt only with the first 20 shocks). Again, the curves are based on the average of all six pairs of Ss; the functions for the individual pairs followed the same trends as the group function. Large sequential changes occurred; the nature of the changes differing for the different durations of shock. The longer shock durations were very effective during the first 40 shock presentations but lost their effectiveness during continued shock presentations. For example, the 3.0-sec duration shocks elicited fighting on 98% of the shocks during the first 40 shocks. From the 81st to the 120th shock delivery, only 78% of the shocks elicited fighting; during the last 40 shocks, the likelihood of fighting was reduced to 40%. In contrast, the briefer shock durations seemed to increase, rather than decrease, in effectiveness as a function of repeated shock deliveries. For example, at the shock duration of .075 sec, fighting occurred only 40% of the time during the first 40 shocks but increased to 65% after 80 shocks had been delivered. At .125 sec, the fighting increased from 60% during the first 40 shocks to about 95% during the second 40 shocks. The intermediate durations of shock showed no appreciable change; for example, the shock duration of .5 sec was about as effective (about 90%) during the first 40 shocks as during the last 40 shocks. The average number of responses per session has not been considered as such because of the sequential changes that occurred within sessions.

DISCUSSION

The elicitation of fighting by foot-shock was a direct function of the duration of the shocks: the longer the duration of shock, the greater was the probability of fighting. Continued delivery of foot-shocks partially reversed this relation. On the one hand, the very brief shock durations became progressively more effective during continued shock presentations. On the other hand, the longer shock durations became progressively less effective. The reason for the increased effectiveness of the briefer shock durations remains unclear. To speculate on the basis for the decrease in fighting at the longer shock duration, gross observation of the rats indicated that the longer shock durations gave ample opportunity for the rats to acquire postures and movements, such as jumping, which reduced the receipt of shock. These escape attempts appeared to compete with the fighting reaction. The briefer shock durations did not appear to produce these marked escape attempts. Gross observation also indicated that the longer shock durations may have indirectly reduced the likelihood of fighting by physically weakening the rats.

The present results resemble the results obtained during a study of the effects of intensity of shock. A previous study (Ulrich and Azrin) revealed that the probability of

fighting was a direct function of shock intensity up to 2 ma. At intensities greater than 2 ma, fighting was elicited less frequently, possibly for the same reasons provided speculatively above. The higher shock intensities, as well as the longer shock durations, appeared to generate competing reactions and physical debility that interfered with the elicitation of fighting. It appears, therefore, that the likelihood of a fighting response is a direct function of the shock severity, that is, either shock intensity or shock duration. The direct relationship between shock severity and fighting appears to be maintained up to the point at which the shock seemed sufficiently severe to produce competing escape reactions and/or physical debility. The optimal value of shock for the continued elicitation of fighting appears to be about 2 ma intensity and about .5 sec duration.

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