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REFLEXIVE FIGHTING IN RESPONSE TO AVERSIVE STIMULATION[1]

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Reflexive fighting was elicited between paired rats as a reflex reaction to electric shock prior to any specific conditioning. Such fighting was fairly stereotyped and easily differentiated from the rats' usual behavior. The strength of this reflex was not attributable to any apparent operant reinforcement. Elicitation of fighting was a direct function of the enclosed floor area and a nonmonotonic function of the shock intensity.

Failure to scramble the polarity of the electrified grid produced inconsistent fighting. Under optimal conditions fighting was consistently elicited by shock regardless of the rat's sex, strain, previous familiarity with each other, or the number present during shock. Repeated shock presentations did not produce an appreciable decrease in fighting until signs of physical debility appeared. Although shock did not cause a rat to attack inanimate objects, it did produce attack movements toward other small animals. Failure of guinea pigs to defend themselves revealed that the elicitation of fighting from the rat does not require reciprocal attack. Paired hamsters showed fighting reactions similar to those of the rats, whereas guinea pigs failed to fight. Electrode shock and a heated floor elicited fighting between the rats, but intense noise and a cooled floor did not.

When electric foot-shock is delivered to paired rats, a stereotyped fighting reaction results (O'Kelly & Steckle, 1939; Daniel, 1943; Richter, 1950). The present investigation studies several possible determinants of this fighting reaction.

METHOD

Subjects

Male Sprague-Dawley rats of the Holtzman strain were used because rats of this strain were found to be very docile and nonaggressive in the absence of electric shock. At the beginning of the experiment the subjects were approximately 100 days old and weighed between 295-335 g. None of the rats had prior experience with the apparatus.

Apparatus

The experimental compartment measured 12 in. by 9 in. by 8 in., two sides of which were constructed of sheet metal and the other two of clear plastic. The floor consisted of steel rods, $\frac{3}{32}$ in. in diameter and spaced 0.5 in. apart. An open chest contained the experimental chamber, thereby permitting a clear view through the transparent door of the chamber. A shielded, 10-watt bulb at the top provided illumination, and a speaker produced a "white" masking noise. An exhaust fan provided additional masking noise as well as ventilation. The temperature was maintained at about 75° F. The various stimulus conditions used were programmed by electrical apparatus located in a room separate from the experimental chamber. A cumulative recorder, counters, and timers provided a record of the responses. Shock was delivered to the subjects through the grid floor for 0.5 sec duration from an Applegate constant current stimulator. A shock scrambler provided a changing pattern of polarities so that any two of the floor grids would be opposite polarity during a major part of each presentation of shock.

PROCEDURE AND RESULTS

Definition of the Fighting Response

When two Sprague-Dawley rats were first placed in the experimental chamber, they

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moved about slowly, sniffing the walls, the grid, and occasionally each other. At no time did any fighting behavior appear in the absence of shock. Soon after shock was delivered, a drastic change in the rats' behavior took place. They would suddenly face each other in an upright position, and with the head thrust forward and the mouth open they would strike vigorously at each other assuming the stereotyped posture shown in Fig. 1.

Fig. 1. Example of the stereotyped fighting posture.

This behavior has typically been referred to as fighting (Scott & Fredericson, 1951), and it was found to be readily identifiable provided that the topography of the response was well specified. For this experiment, a fighting response was recorded by an observer who depressed a microswitch for any striking or biting movement of either or both animals toward the other while in the stereotyped fighting posture. Once a shock was delivered, the subjects would typically assume and maintain this posture for brief periods during which several striking movements might be made. A new response was recorded only for those striking movements which were separated from previous striking movements by approximately 1 sec. Typically, rats struck at each other for only a brief duration (less than 1 sec) following a delivery of shock; therefore, the number of fighting episodes was more easily recorded than the duration of fighting. The duration for which the rats maintained the stereotyped fighting posture could not be reliably measured since this posture often blended imperceptably in time into a more normal posture.

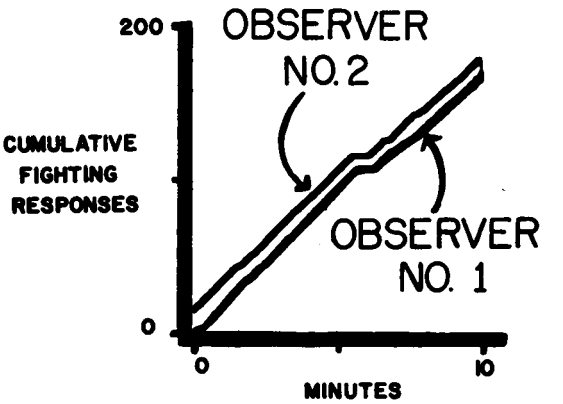

Fig. 2. Agreement between observers in the simultaneous recording of fighting responses.

A measure of the reliability of recording was obtained by having two observers simultaneously score the fighting behavior. Figure 2 shows the cumulative records of the fighting responses which occurred during a 10-min period in which shock was presented at a frequency of 20 shocks per min. The number of fighting responses recorded by each observer agreed within 5%. The parallel slopes of the two lines indicate that there was close agreement between the two observers on both the total number of responses and also on the momentary changes in the rate of fighting.

Frequency of Shock Presentation

Six rats were divided into three pairs, and each pair was exposed to electric foot-shock (2 ma) delivered at frequencies of 0.1, 0.6, 2, 20, and 38 shocks per min. Each of these frequencies was administered during each of three different sessions (10 min per session) with a 24-hr interval usually allowed after each session. The order of presentation of frequencies was irregular. Figure 3 is the rate of fighting for each of the three pairs of subjects as a function of the frequency of shock presentation. The frequency of fighting for

each pair of subjects increased from zero responses in the absence of shock to 33 fighting responses per min at a frequency of 38 shocks per min. Individual differences between the pairs of rats were largely absent; the frequency of fighting of the different pairs of subjects was almost identical at each of the shock frequencies.

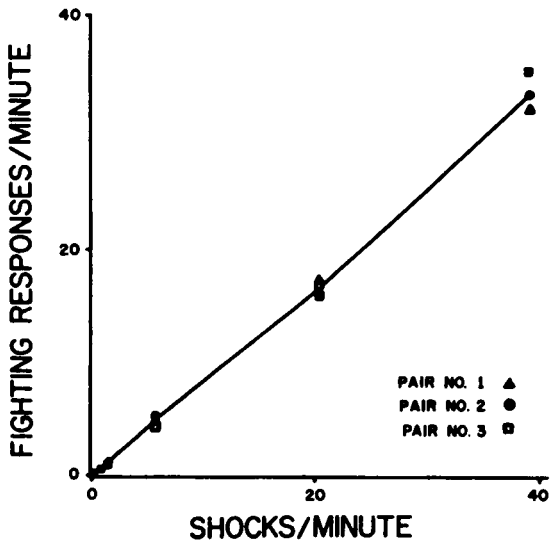

Fig. 3. The elicitation of fighting responses as a function of the frequency of presentation of foot-shock for each of three pairs of rats.

If each delivery of shock produced a fighting response, the rate of fighting would be directly known from the frequency of shock presentation. Indeed, the higher frequencies of shock presentation did result in a relationship of this sort. Shock frequencies in excess of 6 per min produced fighting in response to 82-93% of the shocks (Table 1). Lower frequencies of shock (less than 1 per min) produced fighting in response to no more than 66% of the shocks. Visual observation of the rats revealed that shortly after a shock was presented, the subjects slipped out of the fighting posture and assumed other positions. It was also apparent that fighting in response to shock was more likely if the animals were facing each other at the moment of shock-delivery. Thus, the probability of fighting appeared to be lower at the lower frequencies of shock presentation because of the likelihood that the rats were at some distance from each other. This direct relationship between rate of shock presentation and rate of fighting reversed at very high frequencies. In an additional study with two pairs of rats, the shock was made so frequent as to be continuous. Although occasional fighting responses occurred, much of the behavior of the rats appeared directed toward escape from the experimental chamber. This "escape" behavior appeared to interfere somewhat with the usual

Table 1

Examples of the Consistency of Fighting Elicited by Shock from Three Pairs of Subjects during Two Sessions at Each of the Different Shock Frequencies. The Consistency of the Fighting Reflex is Expressed as the Percentage of Shocks that Resulted in a Fighting Response.

Frequency of Shocks (Shocks/Min.)	*Consistency of Fighting Reflex (Responses) (Shocks)*		
	Pair No. 1	*Pair No. 2*	*Pair No. 3*
0.1	0.33	0.66	0.66
0.6	0.61	0.55	0.61
2.0	0.83	0.58	0.58
6.0	0.83	0.94	0.77
20.0	0.92	0.91	0.82
38.0	0.85	0.89	0.93

reflexive fighting. Such behavior was also noted during the early part of the initial session when the subjects were first presented with shock. However, in this case the escape behavior did not persist.

Intrasession changes in fighting behavior were conspicuously absent (Fig. 4). The bottom curve is the cumulative record of the fighting for a 10-min session in which only one shock was delivered at the middle of the session. This single shock produced an immediate fighting response. At a shock frequency of 0.6 shocks per min (second curve from bottom) the rats did not fight after all of the six shock deliveries, but observation revealed that the four fighting responses which did occur were immediately preceded by the presentation of a shock. At no time did fighting occur during the interval between shock presentations although the stereotyped fighting was often maintained during that time. No warm-up period appeared at the beginning of the session; nor did the frequency of fighting decrease toward the end of the session.

Sequential Effects

Elicitation of the fighting reflex on a given day was virtually independent of the shock frequency used on preceding days or even on the same day. As a rule, the number of fighting responses at a given shock frequency varied less than 10%, irrespective of the preceding shock frequency. On several occasions, the sessions followed within 10 min of each other in order to determine the effects of a shorter interval between sessions. At a frequency of 2 shocks per min, 68% of the shocks were effective when 24 hr were allowed between sessions; 63% of the shocks were effective when only 10 min were allowed between sessions. This small difference in responding as a function of the interval between sessions was typical. The strength of the fighting reflex appears to be fairly independent of its history of elicitation.

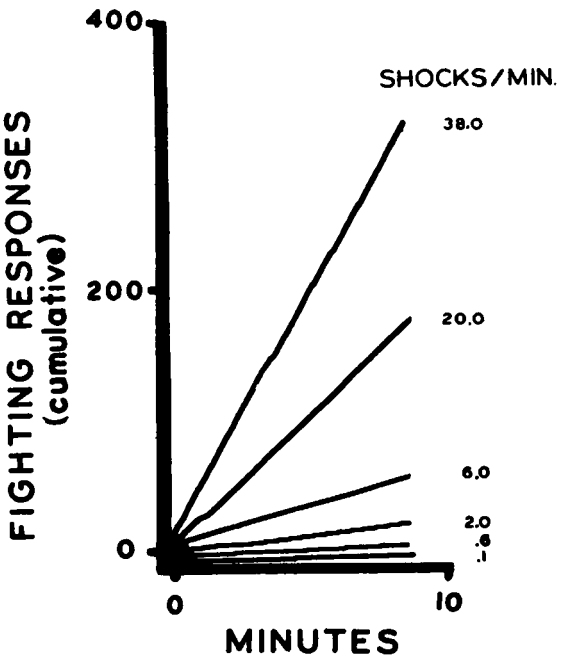

Fig. 4. Typical curves for one pair of rats of the fighting responses at various frequencies of presentation of shock.

Reflex Fatigue

Figure 2 revealed little change in the consistency with which the fighting reflex was elicited, even after 300 elicitations at the higher rates of shock presentation. In order to evaluate reflex fatigue, frequent shocks (every 1.5 sec) were delivered to a pair of rats for an uninterrupted period of 7½ hr. The fighting reflex proved extremely resistant to fatigue (Fig. 5). During the first 2400 presentations (1 hr) of the shock, fighting was elicited after 82% of the shocks. After 7200 presentations of shock (third hour), fighting still occurred after 70% of the shocks. Only during the last 1.5 hr, after 6 hr and nearly 15,000 shocks, did the consistency of elicitation drop below 40%. By this time the rats were damp with perspiration and appeared to be weakened physically. By the end of the 7.5 hr, approximately 10,000 fighting responses had been elicited. Several observers were required because of the extended observation period.

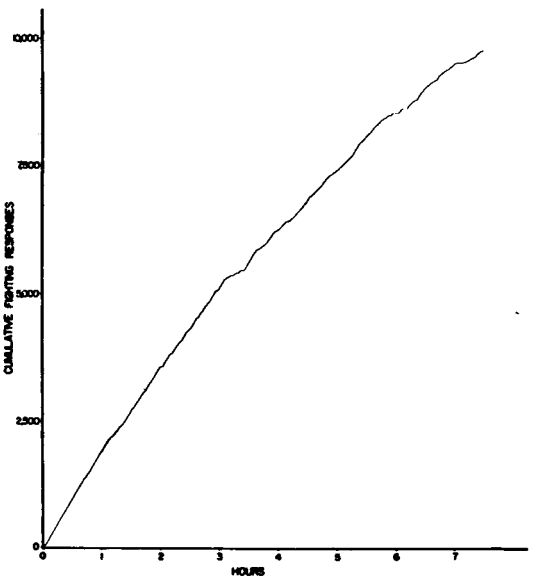

Fig. 5. Cumulative record of the fighting responses that were elicited from a pair of rats during a long period (7.5 hr) of frequent (every 1.5 sec) shock presentation.

Intensity of Shock Presentation

Three pairs of rats were exposed to various intensities of shock at a fixed frequency of 20 shocks per min. Each intensity was presented for at least 10 min. The sequence of intensities was varied and several 10-min periods were given at each intensity. The cumulative-response curves of Fig. 6 for one pair of rats were typical of those obtained with all three pairs of rats. Increasing the shock intensity

from 0-2 ma produced an increased frequency of fighting; at still higher intensities (3-5 ma), the rate of fighting was somewhat reduced. Visual observations indicated that lower intensities produced a fighting response of less vigor and longer latency. Also, at the lower intensities, chance factors, such as the orientation of the rats relative to each other and to the grid floor, appeared to influence greatly the likelihood of a fighting response. If the

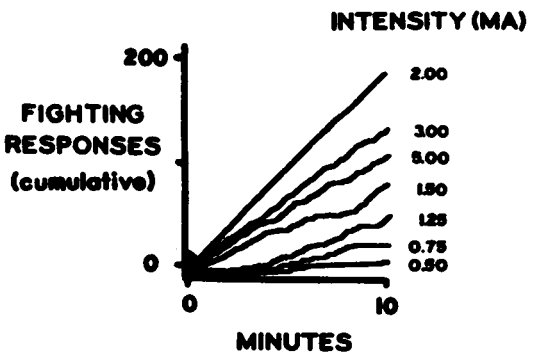

Fig. 6. Typical cumulative records of the fighting responses that were elicited from one pair of rats at various intensities of foot-shock.

rats were making good contact across several of the floor grids, and were also oriented toward each other, a fighting response was likely to result. Even so, this response was relatively short in duration, slow in onset, less vigorous, and less likely to result in a maintained fighting posture than the responses elicited by the higher current intensities. At these lower intensities, the definition of a movement as a fighting response often became arbitrary. At the higher intensities, the attack movement was unmistakable.

The slight decrease in fighting behavior at the highest intensity (5 ma) appeared to be partly a consequence of the debilitating effects of the shock. Prolonged exposure to this intensity often resulted in a complete loss of fighting because of the paralysis of one or both of the subjects. Even during the initial exposure to this very high intensity, fighting behavior appeared to be reduced by the strong tendency of the rats to engage in other shock-induced behavior, such as biting the grids, jumping, running, or pushing on the walls.

Thus, the optimal current intensity for eliciting fighting was approximately 2 ma. At lower intensities, the shock did not appear to be sufficiently aversive, while at higher intensities, the shock appeared to be debilitating and generated competing behavior. Tedeschi (1959) also found that 2 to 3-ma intensity is optimal for producing fighting between mice.

Uniformity of Shock Presentation

All previous investigations of shock-produced fighting appear to have used the same type of shock circuit. Alternate bars of the floor grid have been wired in parallel so that adjacent bars were of opposite polarity, but many nonadjacent bars were of the same polarity. Such a design permits the rat to avoid the scheduled shocks by standing on bars of the same polarity. Skinner and Campbell (1947) found that this unauthorized avoidance could be eliminated by a scrambling circuit which insured that any two bars would be of opposite polarity during a major part of each shock delivery. A scrambling circuit of this sort was used throughout the present investigation. Three pairs of rats were now studied to determine the effects of omitting this scrambling circuit. An hour-long period of shock (2-ma intensity at a rate of 20 per min) was given to each pair of rats on each of three successive days. On one or two of these days, the scrambler was omitted. For all three pairs of rats, the omission of the scrambler produced less than half as many fighting responses as were obtained with the scrambler. The curves in Fig. 7 for one pair

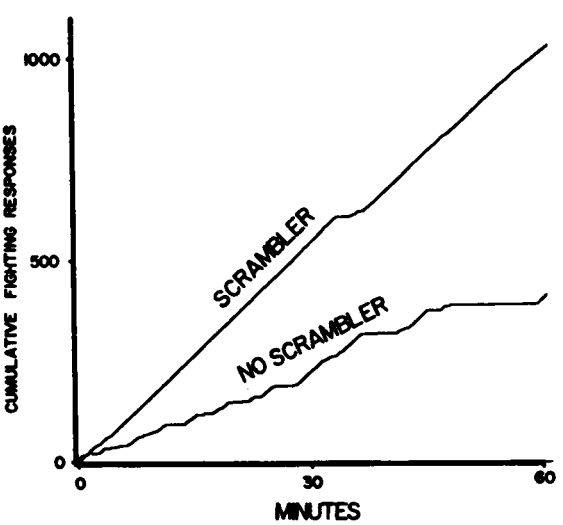

Fig. 7. The elicitation of fighting responses by foot-shocks that were delivered with or without a polarity scrambler for the floor grids.

of rats reveal great variability in the frequency of fighting; periods of frequent fighting alternate with periods or little or no fighting. Visual observation revealed that one or both rats often avoided shocks by standing on bars of like-polarity. This safe posture was often maintained for several minutes during which no fighting was produced. When a part of the rat happened to contact a bar of different polarity, the resulting shock usually jolted the rat out of this safe posture. For the next few minutes, the rat was likely to receive the scheduled shocks and fighting resumed until once again a safe position was discovered. When the scrambler was in use, no safe position was possible and the rats typically fought immediately following each scheduled shock. The omission of a polarity scrambler in past studies may account for the frequent failure of shock to elicit fighting behavior (Miller, 1948; Richter, 1950).

Previous Experience

In this study, each rat had been housed individually and had no prior contact with his fighting-mate. This general unfamiliarity of the rats with each other might have been a factor in obtaining the fighting response to shock. This possibility was evaluated by housing two rats together in a single cage for several weeks. Subsequent exposure to foot-shock in the experimental chamber produced the same degree of fighting that had been obtained when the same rats had been housed separately. These results were replicated with 24 other animals. It appears, therefore, that previous familiarity of rats with each other does not appreciably effect the elicitation of fighting through foot-shock. On the other hand, nonreflexive fighting behavior has been found to be affected by previous familiarity (Seward, 1945).

Sex

Male rats are known to fight more often than female rats in a natural (no-shock) situation (Beeman, 1947; Scott & Fredericson, 1951). The relevance of sex for the elicitation of fighting by foot-shock was investigated by pairing a female rat with a second female, and a male rat with a female. Several such pairings revealed the same type of fighting in response to foot-shock (2 ma, 20 deliveries per min) as had been obtained between the two male rats. Indeed, the sexual behavior between the male-female pair was completely displaced by the elicitation of fighting soon after the first few shocks were delivered. Unlike "natural" fighting behavior, reflexive fighting behavior does not appear to be appreciably affected by sexual differences.

Number of Rats

Reflexive fighting also resulted when more than two rats were shocked. When 2, 3, 4, 6, or 8 rats were simultaneously given foot-shock, the same stereotyped fighting reaction occurred, two or more rats often aggressing against a single rat.

Size of Chamber

Throughout the present study the size of the experimental chamber was 12- by 9- by 8 in. In this phase a pair of rats was given shock (2 ma) for 10 min (20 shocks per min) in a square chamber having an adjustable floor area. The height was held constant at 17 in. Figure 8 shows the number of fighting responses as a function of the floor area at each of the different floor sizes. With only a very small amount of floor space (6 by 6 in) the fighting response was elicited by approximately 90% of the shocks. At the larger floor areas, the number of fighting responses de-

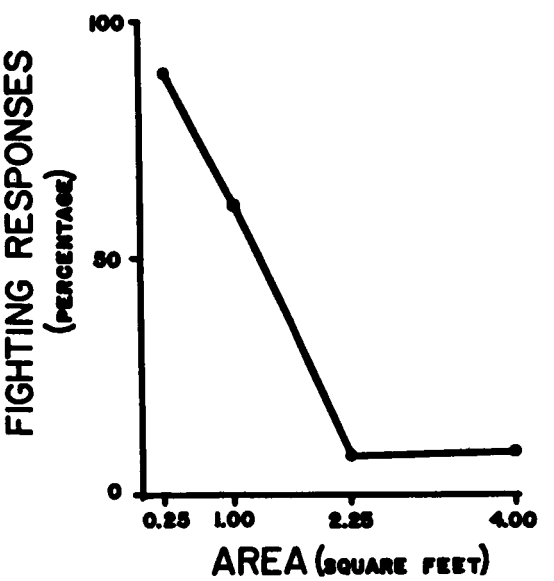

Fig. 8. Elicitation of fighting responses from two rats by foot-shock in a square chamber of constant height and variable floor area.

creased; with the largest floor space (24 by 24 in), only 2% of the shocks elicited fighting. The amount of fighting between rats in response to shock appears to depend critically upon the amount of floor space in the fighting chamber. When the rats were only a few inches apart, the shock was likely to cause them to turn and lunge at each other. At the larger distances, the rats largely ignored each other.

Strain

As mentioned above, the Holtzman Sprague-Dawley rats are unusually docile in the absence of shock. Additional study revealed that other less docile strains of rats also exhibited this shock-elicited fighting. Two pairs of mature male rats from four other strains (Long-Evans hooded, Wistar, General Biological hooded, Charles River Sprague-Dawley)[2] were exposed to the optimal shock conditions (2 ma at 20 shocks per min) in the same experimental chamber (12 by 9 by 8 in) as had been used for the Holtzman strain. In all of the strains the same stereotyped fighting reaction occurred following the presentations of shock. However, less than 50% of the shocks produced fighting between rats of the Wistar strain, whereas over 70% of the shocks produced fighting between rats in each of the other strains. The Wistar rats appeared to be more sensitive to the shock since much competing behavior was generated by shocks of 2-ma intensity, and two out of the four Wistar rats died after exposure to these shocks. Apart from this seemingly greater sensitivity of the Wistar-strain rats, all of the strains showed the same stereotyped fighting response to foot-shock.

Species

Mature guinea pigs and hamsters were studied under the same conditions of shock presentation and in the same experimental chamber to ascertain the existence of reflexive fighting in other species. Delivery of shock to a pair of hamsters produced a similar type of stereotyped fighting posture and attack as was seen with rats. These fighting responses could be consistently elicited at lower intensities of shock (0.75 ma) than was required with the rats. Also, the hamsters persisted longer in their fighting, often biting and rolling over each other. Tedeschi (1959) found that paired mice also fought vigorously in response to foot-shock. In contrast, the paired guinea pigs never showed the fighting posture or any attack movements in response to shock. Variations in the intensity and frequency of shock presentation, as well as food deprivation up to 72 hr, did not alter this failure to fight.

Interspecies Fighting

When a Sprague-Dawley rat was paired with a hamster, shock produced the same fighting reaction by both animals. However, when a rat was paired with a guinea pig, all of the attacking was done by the rat. The guinea pig reacted only by withdrawing from the rat's biting attacks following the shock delivery. The rat attacked only the head of the guinea pig. During this attack, the rat assumed a semi-crouching position with the forepaws raised only slightly off the floor, a posture which differed from the upright position assumed by rats in fighting each other. Since the guinea pig never stood upright, the crouching position of the rat brought its head to the level of the guinea pig's head. The otherwise inflexible and stereotyped fighting posture of the rat appeared to be modified by the position of the guinea pig. No fighting occurred in the absence of shock.

Inanimate Objects

When an insulated doll was placed into the experimental chamber while a rat was being shocked, no attack was attempted. Similarily, no attack movements were made toward either a conducting doll or a recently deceased rat. Dolls moved rapidly about the cage also failed to produce fighting. Fighting responses were elicited only when the dead rat was moved about the cage on a stick.

Electrode Shock

In using foot-shock, both rats are shocked simultaneously since they are standing on the

[2]The different strains of rats were obtained from the following suppliers:
Long-Evans hooded: Small Animal Industry, Chamberland, Indiana;
Wistar: Albino Farms, Redbank, New Jersey;
General Biological Hooded: General Biological Supply House, Inc., Chicago 20, Illinois;
Charles River Sprague-Dawley: Charles River Laboratories, Inc., Brookline 46, Massachusetts;
Holtzman Sprague-Dawley: Holtzman Company, Madison, Wisconsin.

same grid floor. Does the elicitation of fighting require that both rats be shocked? This question might be investigated by electrifying only that section of the grid under one of the rats. However, the rat quickly learns to stand on a nonelectrified section. A second solution is to shock the rats through implanted electrodes. The two rats were placed in an experimental chamber, and electrodes were implanted beneath a fold of skin on the back of one rat. A harness and swivel arrangement allowed the rat complete freedom in moving about. When a 0.5 sec shock was delivered at an intensity of 2 ma, only a spasmodic movement of the rat resulted if no other rat were present. When the shock was delivered in the presence of a second rat, the stimulated rat usually assumed the stereotyped fighting posture and attacked the unstimulated rat. Upon being attacked, the unstimulated rat in turn often assumed the stereotyped posture and returned the attack. Once the attack was initiated by the shock, the continuance of the fighting appeared to be partly under social control. Fighting was elicited, then, even when only one member of the pair of rats was stimulated. Somewhat the same result was seen above when foot-shock elicited fighting in a rat paired with a guinea pig, in spite of the failure of the guinea pig to reciprocate. Similarly, in the course of delivering foot-shock to a pair of rats, occasionally a rat would learn to eliminate the shock by lying motionless on its back, thereby producing a situation in which only one rat was being stimulated. Under these circumstances, the rat stimulated by foot-shock often attacked the supine rat in the same way that the rat stimulated by electrode shock attacked the unstimulated rat. It should be noted that in each of these situations where only one rat was being stimulated, the full-blown fighting response was elicited less frequently than when both rats were stimulated. Stimulation of a second rat is not a necessary condition for proudcing the fighting reaction but does, nevertheless, increase the likelihood of its occurrence.

Intense Heat

The elicitation of the fighting reflex through electrode-shock as well as foot-shock suggested that other aversive stimulation also might elicit fighting. A pair of rats was placed in an experimental chamber with a thin metal floor that could be heated from below by a heating coil. After the heating coil was energized, the metal floor became progressively hotter and the two rats began jumping about and licking their feet. No fighting was produced in spite of the agitated movements of both rats. However, when the same pair later was placed on a preheated floor, fighting consistently resulted. The same results were obtained with additional rats. The rats scrambled about the chamber, interrupting their movements frequently to assume a fixed position and attack each other before resuming their running about. It is very likely that the rats received more painful heat stimulation during the fighting episodes than they would have received if they had jumped about. No more than 2 min of exposure to the heated floor was given because of the possibility of tissue damage. Nevertheless, the heated floor appeared to elicit fighting in much the same manner as a continuously electrified floor grid. It is probable that the gradual heating of the floor grid allowed the reinforcement of competing behavior, especially licking of the forepaws. This wetting the paws appeared to be effective in cooling the animal at the initially lower temperature of the gradually heated floor but not at the high temperature of the preheated floor. Once fighting was elicited by a preheated floor, subsequent exposure to a gradually heated floor did elicit some fighting, and the competing licking behaviors were reduced.

Cold and Intense Noise

In spite of the effectiveness of intense heat in eliciting fighting behavior, no fighting was elicited by placing rats on a sheet metal floor pre-cooled by dry ice. It is possible that the temperature induced by the dry ice was not sufficiently aversive; no pain was felt by a human observer upon touching the cooled floor for periods less than 2 sec. Since the rats were consistently moving about, it is quite likely that they did not allow a given paw to remain in contact with the cold floor for a sufficient period of time. Since the cool floor did not produce pain upon immediate contact, unlike electric shock and heat, the rat probably could eliminate pain completely in much the same manner as the rat lying upon its insulated back can completely eliminate painful foot-shock.

Intense noise was similarily ineffective in producing fighting behavior between paired rats. The noise was at an intensity of 135 db (*re* 0.0002 dyne/cm^2) and enclosed a band from 200-1500 cps. The delivery of noise was varied from brief bursts of less than 1 sec to periods of more than 1 min. No fighting resulted. A pair of guinea pigs was subjected to the same treatment in the expectation that guinea pigs might be more reactive to intense noise. No fighting resulted.

Fighting appears to be elicited by foot-shock, electrode shock, and intense heat, but not by intense noise or moderate cold.

DISCUSSION

The present investigation found that fighting behavior could be elicited from several paired species by several different types of aversive stimulation. The elicitation of this fighting occurred in almost a one-to-one relationship to the aversive stimulus when the optimal value of the aversive stimulus was used. When a response, such as salivation, is consistently made to a stimulus, such as meat powder, with no previous training, that response is referred to as an unconditioned response (Pavlov, 1927; Sherrington, 1947) or as a respondent (Skinner, 1938). Physiologists have supplied us with the term reflex to designate such specific stimulus-response relationships and in fact have extended the term to denote responses for which related stimuli are not always clearly observable (Keller & Schoenfeld, 1950). The consistent elicitation of the fighting response by aversive stimulation without prior conditioning appears to be best defined as an unconditional reflex. Miller (1948), however, has taken a different approach in the study of fighting behavior. He reports that he trained his subjects to fight by removing the shock each time the animals approximated the fighting position. In this case fighting is presumed to be an escape reaction that is reinforced by the termination of electric shock. In spite of the virtual one-to-one relationship between shock and fighting observed in the present study, it is possible that this apparently reflexive fighting was maintained by some unsuspected and perhaps subtle operant reinforcement. Several possible sources of operant reinforcement seem apparent. First, it is possible that the rats were simply attempting to stand on each other in order to eliminate the aversive stimulation. Several observations made during the course of these experiments bear upon this interpretation: (1) When one of a pair of rats was lying on its back and effectively avoiding all shock, the shocked rat, rather than attempting to climb upon the other rat, often directed an attack specifically at the other rat's head. (2) Fighting was maintained by electrode shock even though no escape was available to the rat stimulated through the electrodes. (3) Leaning against the other rat eliminated the shock no more than simply leaning against one of the insulating plastic walls of the experimental chamber. (4) On the heated floor, the fighting behavior served to increase rather than decrease the amount of aversive stimulation. (5) When an insulated doll was placed in the experimental chamber while a rat was given foot-shock, no attempt was made by the rat to jump upon the doll until several minutes of stimulation had elapsed.

A second possible source of operant reinforcement of fighting is that the fixed-duration shock delivery happened to terminate at the moment that the rats moved toward each other; thus, superstitious reinforcement of these movements would have resulted (Skinner, 1948). Again, several observations indicated that reinforcement of this sort was not operative in producing fighting: (1) Fighting often occurred with the onset of the first shock delivery when prior reinforcement through shock reduction was necessarily impossible. (2) Continuous and uninterrupted delivery of either foot shock or severe heat produced fighting. Of course, no reinforcement through the termination of the stimulus can result if the stimulus is not terminated.

A plausible interpretation of the fighting reflex is that a rat will attack any nearby object or organism upon being aversively stimulated. However, rats did not attack a nearby doll, either insulating or conducting, upon being shocked. Nor was the movement of an inanimate object in the presence of a shocked rat a sufficient condition for eliciting fighting. No fighting resulted when the dolls were moved about the cage at the end of a stick during and between shock presentations. Additional experiments revealed that even a recently deceased rat would not be attacked by a second rat that was given foot-shock,

unless the dead rat was moved about the cage on a stick. It would seem, therefore, that a second moving animal either rat, guinea pig or hamster is a necessary condition for eliciting the fighting response from a rat stimulated by foot-shock.

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