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PAIN-AGGRESSION TOWARD INANIMATE OBJECTS[1]

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Attack behavior was elicited from squirrel monkeys by externally applied electric shock. The shock elicited attack toward other monkeys, rats, and mice, as well as toward inanimate objects, such as a stuffed doll, and even a round ball. A method of quantifying the attack behavior was devised on the basis of the attack against inanimate objects. This method revealed that the duration and probability of attack was a direct function of the shock intensity.

Previous findings (Azrin, Hutchinson, and Hake, 1963) revealed that squirrel monkeys attacked each other upon being stimulated by pain-shock. The present investigation attempted to answer several questions about the elicitation of attack by squirrel monkeys. Will attack be elicited toward animals of other species? Will an inanimate object be attacked? What is the temporal course of this attack? How does the duration of attack vary with the intensity of the eliciting shock? Can objectively defined measures of attack be devised?

EXPERIMENT I

Method

Fourteen male squirrel monkeys, with an average weight of 531 g in a range of 350-800 g, served as subjects. All had lived together in a community living cage initially but were housed individually during this study. Food and water were available continuously in the living cages.

The experimental chamber, 36 by 24 by 31 in. high, was large enough to minimize or eliminate accidental contact between animals. Foot-shock was delivered from the 400 v ac output of a transformer through a 10K ohm series resistor attached to the floor, which was constructed of parallel rods. The shock duration was .15 sec. A shock scrambling device was used similar to the one designed by Hoffman and Fleshler (1962). Each *S* was placed individually in the experimental chamber. Then one of the following five objects or animals was placed in the chamber with the *S*: (1) another squirrel monkey, (2) a rat, (3) a mouse, (4) a stuffed doll, and (5) a ball. For each of these five animals or objects, an initial 10-min period was provided during which no shock was delivered (pre-shock period). A foot-shock was then delivered every 15 sec for a total of 10 shocks. Then, the shocks were discontinued and *S* was removed from the chamber. After a minimum of 30 min had elapsed, *S* was returned to the chamber and paired with one of the four remaining objects or animals. The sequence of presentation of the five objects or animals was varied among *S*s. The rats that served as the object of attack were male, Sprague-Dawley Holtzman, 90-180 days of age. The mice were male, 60-120 days of age, and were obtained from the Midwest Animal Colony, Corning, Iowa. The doll had a black and white cloth covering, was stuffed with cotton, and measured 3 in. by 5 in. by 10 in. high. The ball was a standard tennis ball covered with terrycloth. The monkey that served as the object of attack was selected at random from a separate group of six monkeys. A smaller chamber (18 by 24 by 31 in. high) was used when the inanimate objects were paired with the monkey.

An attack was defined by the observation that *S* bit into the object or animal with which it was paired.

Results

Eleven of the 14 *S*s made at least one attack upon another monkey, as well as upon the rat,

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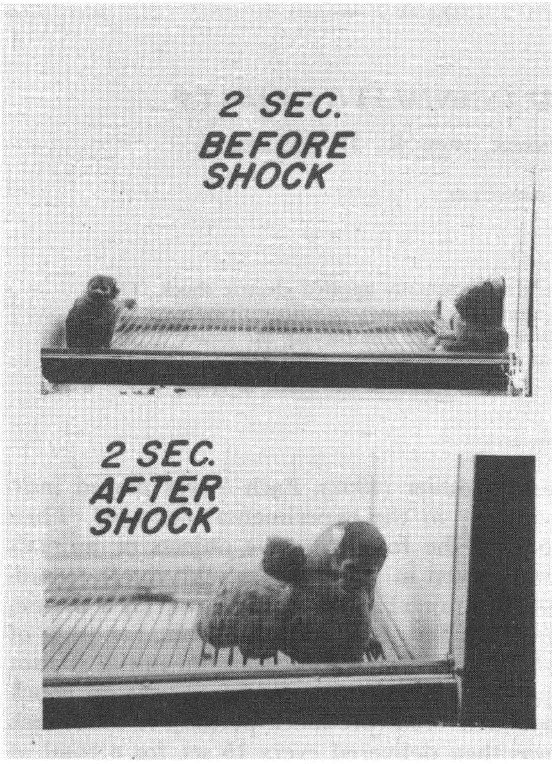

Fig. 1. Example of pain-aggression toward a stuffed doll. A stuffed doll was located on one side of an enclosed chamber. A squirrel monkey remained relatively motionless (upper portion) until a brief pain-shock was delivered through the floor grid, at which time the monkey sunk its teeth into the doll (lower portion of Fig.).

the mouse, the stuffed doll, and the terrycloth covered ball. The other three *S*s did not initiate attack against any of the animals or objects with which they were paired. Not a single attack was made by any of the 14 *S*s toward any of the animals or objects during the 10 min pre-shock periods. During the shock period, only some of the shocks elicited an attack. When an attack did occur, the attack always took place within 1 or 2 sec after a shock presentation. No attempt was made to evaluate the exact proportion of attacks against the different objects or animals since the occurrence of an attack appeared to depend on such accidental factors as the size, movement, position, conspicuousness, *etc.* of the objects or animals. The attack between two monkeys was similar to that reported earlier (Azrin *et al.*, 1963). The monkeys raced at each other a moment after the shock delivery and began biting each other. For two *S*s, the attack became one-sided: by the seventh shock, one *S* would initiate the attack, the other fighting only in defense. The emergence of this dominant-submissive relation has been noted in previous observations. Both monkeys will initiate an attack during the first few shock deliveries; after an extended series of shocks, one monkey (usually the heavier one) will consistently initiate the attack while the second monkey flees.

When the rat was paired with the monkey, the *S* always initiated the attack. In six instances, the rat bit the *S* but this aggression did not prevent continued attack by the *S*. A different rat was used for each of the 11 attacking *S*s because of the serious physical injury often inflicted on the rat.

When the mouse was paired with the *S*, the attack was completely one-sided. Each of the 11 attacking *S*s fatally injured the mouse with which it was paired. Successive shocks caused *S* to attack the lifeless mouse. When *S*s were paired with the stuffed doll, they repeatedly sunk their teeth into the doll (see Fig. 1); the doll was torn so badly that two replacements were required. When *S*s were paired with the cloth-covered ball, the cloth covering was shredded by the extensive tearing by each *S*.

EXPERIMENT II

The procedure of Exp. I had relied upon gross observation of the attack behavior in a free field situation. A second experiment was conducted to study the attack behavior in a more objective manner. An automatic recording system was developed and used to quantify the temporal course of attack against an inanimate object. Of the 14 monkeys used in Exp. I, 11 were again used for this experiment. The three monkeys that failed to attack were excluded.

Method

A special chair (Hake and Azrin, 1963) was used to hold the *S* in a loosely restrained position while allowing the delivery of pain-shock through tail electrodes (see Fig. 2). A cloth-covered tennis ball was suspended at approximately the eye-level when *S* was seated and upright. This level minimized or eliminated accidental contact of *S* with the ball since *S* usually sat in a crouched posture as seen in the left panel of Fig. 2. The ball could be bitten only by pulling it toward the mouth as seen

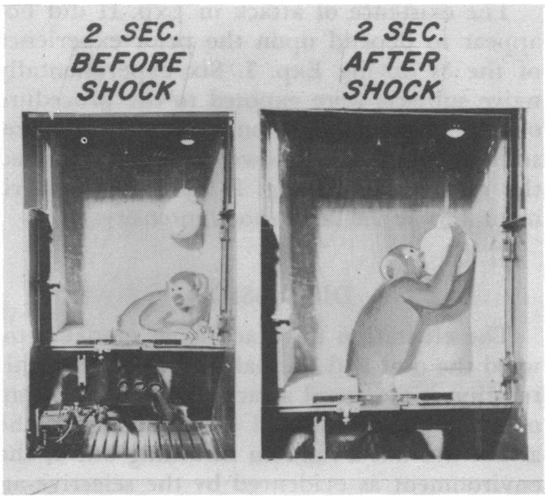

Fig. 2. In the left panel, a squirrel monkey is seated in a restraining chair. A ball and a metal box are suspended overhead. (The view of the box is obstructed by the ball). After a brief shock has been delivered through the tail-electrode, the squirrel monkey attacks the ball, sinking its teeth into it (right panel).

in the right panel of Fig. 2. The wire by which the ball was suspended was attached to a switch which closed when the ball was pulled with a force exceeding 70 g. A metal box 1 in. by 2 in. by 3 in. was suspended at the same height and in the same manner as the ball but from its own switch. For half of the *S*s, the ball was on the left and the metal box on the right; for the other half, the positions of the ball and box were reversed. The two objects were suspended in such a way that they were motionless unless actively displaced by *S*. Upon being released by *S*, the objects again became motionless within 2 to 3 sec.

In this experiment, shock was delivered through surface electrodes on the tail instead of foot-shock through a grid floor. The tail-shock was 60 cps ac and was delivered through a 10K ohm series resistor which provided stabilization of the current flow. Each shock lasted for 100 msec. The brevity of this shock prevented any superstitious reinforcement through accidental coincidence of a response with shock termination. Four shock intensities were used: 50 v, 100 v, 200 v, and 400 v as well as a control period of no shock (0 v). An ascending series followed by a descending series of intensities was used for half of the *S*s: 0-50-100-200-400-400-200-100-50-0; for the other half, the sequence was reversed: 400-200-100-50-0-0-50-100-200-400. Thirty shocks were delivered 15 sec apart at each intensity during the ascending and descending series, thereby providing a total of 60 shocks for each intensity. A 5-min period without shock preceded each block of 30 shocks.

The attack behavior was recorded in two ways. The first method was automatic; a pen in an Esterline Angus recorder was activated upon closure of the switch from which the cloth ball or the metal box was suspended. In the second method, a pen was activated when an observer closed a handheld microswitch. The observer closed this switch for as long as the *S* was making contact with the inanimate object with its teeth and was simultaneously moving its jaws. A series of 10 counters was used to record the moment of occurrence of attack. The counters provided a measure of the probability of attack during successive 1.5-sec intervals after delivery of a shock. A single response count was registered on the appropriate counter if attack was occurring at any time during the 1.5-sec interval specified for that counter.

Results

Figure 3 shows the probability of an attack at different times after the delivery of shock; the intensity of shock is the parameter. Probability is computed by dividing the number of attacks by the number of shocks for each 1.5-sec interval. Only one response was registered

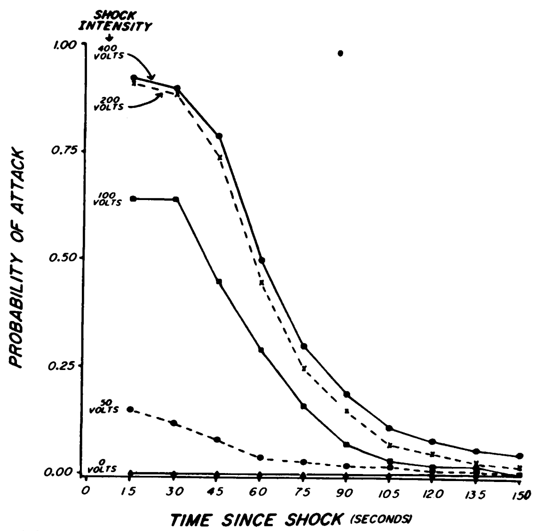

Fig. 3. The probability of an attack upon an inanimate object (ball) by squirrel monkeys as a function of shock intensity. Shock was delivered through tail-electrodes.

on a given counter even if the attack stopped momentarily and then started again within the 1.5-sec interval specified by that counter. Thus, the number of attacks within a given 1.5-sec interval cannot exceed the number of shocks. An attack probability of 1.0 for a given interval means that every shock resulted in the occurrence of attack at some time within that interval. Each point is the average of all 11 *Ss*. The scores for the ascending and descending series of intensities were combined since no significant difference was found between the two series. It can be seen that the probability of an attack was a direct function of the shock intensity. Not a single attack was made in the absence of shock (0 v); at 200 v and at 400 v the probability of attack was about .95 during the first 1.5-sec interval. The probability of attack was greatest within the first 3 sec following a shock, falling off sharply until the probability of attack approached zero within 12 sec after shock delivery. The greater the shock intensity, the longer the attack lasted. For example, the probability of attack dropped below .1 in about 5 sec at 50 v, in 9 sec at 100 v, and 10.5 sec at 200 v. The curves for the individual *Ss* were similar to the average curve in that the probability and the duration of attack was a direct function of the shock intensity for every *S*. None of the *Ss* made a single attack at 0 v; for all *Ss* the probability of attack exceeded .80 at 200 v and 400 v.

The attacks were directed almost exclusively at the ball rather than the metal box. Out of a total of 1778 attacks, only 104 were directed at the box (less than 6%). The cloth covering on the ball was replaced regularly because of the tearing that resulted from the attack.

The two methods of recording attack showed close agreement. The probability of attack, as automatically recorded by the switch connected to the object, differed from the probability recorded by the observer by 0.0, .06, .03, .01, and .01 for the intensities of 0 v, 50 v, 100 v, 200 v, and 400 v respectively. The major source of this small discrepancy was contributed by two *Ss*, one of which occasionally grasped the ball vigorously but did not always follow through with biting. For the other *S*, the ball apparently was not suspended high enough since *S* could occasionally bring the ball to its mouth and bite vigorously without activating the switch.

The existence of attack in Exp. II did not appear to depend upon the prior experience of the *Ss* during Exp. I. Six experimentally naive subjects were exposed to the procedure of Exp. II at a shock intensity of 400 v. The results obtained (not shown) closely paralleled the results seen in Fig. 2 for the 11 experimental *Ss* at the same shock intensity.

DISCUSSION

The elicitation of attack from monkeys toward the doll and the ball indicated that this reaction is a general attack upon the environment, inanimate as well as animate. Yet, the attack was not a random thrashing out at the environment as evidenced by the selective attack upon the cloth-covered ball, rather than the metal box, when both inanimate objects were simultaneously available. Previous efforts to elicit attack from rats against inanimate objects were unsuccessful (Ulrich and Azrin, 1961). This failure may reflect the apparently lower level of aggressiveness in the domesticated rat as compared with the squirrel monkey.

The elicitation of attack by monkeys toward inanimate objects made possible several methodological refinements in the study of the pain-aggression reaction. When two monkeys were used, the duration of aggression was usually complicated by the degree to which the attacked animal defended itself (reciprocal aggression). When the inanimate object was used to eliminate the possibility of reciprocal attack, the tendency to attack was restricted to a brief period following the pain-shock. A second advantage to the use of inanimate objects was that the object could be easily fixed in position relative to the aggressor. The third, and principal, advantage of using inanimate objects was that automatic recording equipment could be used, thereby reducing the complete reliance upon gross visual observation that has characterized previous measures of attack behavior.

Two of the three *Ss* that failed to attack were smaller than the others (less than 400 g). This lower weight may reflect the physical immaturity or ill-health of a monkey. These three *Ss* were later paired with each other as well as with each of the other 11 *Ss*. Fighting was never initiated by these three during any of these pairings. Nor could fighting be elicited by increasing the frequency of shock up to 20 per min or the intensity of shock up to 600 v. For the other 11 *S*s, the probability of attack was a direct function of intensity of the tail-shock. Previous studies that used foot-shock have reported a non-monotonic relation between shock severity and fighting (Tedeschi, 1959; Ulrich and Azrin, 1962; Azrin *et al.*, 1963), reportedly because of the debilitating and tetanizing effects of very intense foot-shock. The monotonic relation in the present study may be related to the apparent absence of debilitation from the use of the localized tail-shock as compared with foot-shock.

Our laboratory experience has been that Sidman avoidance performance (Sidman, 1953) is acquired almost immediately with squirrel monkeys. The squirrel monkey often bites the projecting response bar as well as other projecting objects shortly after the shock delivery. It may well be that acquisition of bar-pressing in a shock avoidance situation is facilitated by the existence of the pain-aggression reaction.

The aggression observed in this study should be distinguished from the aggressive behavior that results from operant reinforcement. Past studies have shown that the probability of aggression will increase if the aggression results in favorable consequences such as an increase of food (Skinner, 1959; Reynolds, Catania and Skinner, 1963), a decrease in painful stimulation (Miller, 1948), access to a female by a male (Tinbergen, 1951), protection of the young by a mother (Smith and Hosking, 1955), maintenance of territorial privileges (Tinbergen, 1951, 1953), training through successful aggression (Kahn, 1951), competition over food (Scott, 1948; Fredericson, Story, Gurney and Buttersworth, 1955), *etc.* The increased aggression that results from these favorable consequences is in agreement with the Law of Operant Reinforcement which states that the probability of a response (aggression would be one such response) will increase if that response results in a favorable consequence (Skinner, 1938). However, we are unable to account for the pain-aggression reaction on the basis of the Law of Operant Reinforcement since no favorable consequence seems to exist for the aggression. The results of previous studies (Ulrich and Azrin, 1962) excluded superstitious reinforcement, previous experience with electric shock, previous familiarity with the other animal, food deprivation, and social isolation as prime determinants of the fighting reflex. Yet, it is possible that pain produces attack because of a learned association in the past between pain and the presence of another animal. For example, O'Kelly and Steckle (1939) have suggested that the aggressive reaction to pain may result from "projection." Presumably, the stimulated animal "believes" that the sudden pain has been inflicted by a nearby animal and therefore attacks him. The attack against inanimate objects does not support this suggestion since it is difficult to conceive of a generalization process that would cause a stationary sphere to become so strongly associated with pain. In the present study, some *S*s received their initial exposure to shock in the presence of the doll or the ball. The existence of attack under these circumstances demonstrates that prior association of pain-shock with another animal is not necessary for the elicitation of attack against inanimate objects. Hutchinson (in process) has studied the experimental basis of this reflex directly by isolating rats from any social contact shortly after weaning. When these isolated rats were stimulated by pain-shock as adults, fighting resulted. It appears necessary to consider the pain-aggression reaction as a type of reflexive reaction and not as a response that is being maintained by improved adjustment or functional utility, past or present.

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