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PUNISHMENT OF ELICITED AGGRESSION

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Aversive shocks are known to produce aggression when the shocks are not dependent on behavior and to suppress behavior when the shocks are arranged as a dependent punisher. These two processes were studied by presenting non-dependent shock to monkeys at regular intervals, thereby producing biting attacks on a pneumatic tube. Immediate shock punishment was simultaneously delivered for each biting attack. The attacks were found to decrease as a function of increasing punishment intensity. These results show that aggression is eliminated by direct punishment of the aggression even when the stimulus that is used as a punisher otherwise causes the aggression.

Aversive shock changes behavior in a direction that is determined by the temporal relation of the shock to the behavior. If the response terminates shock, the rate of that response increases and the process is called escape (see recent review by Dinsmoor, 1968). If the response produces the shock, the rate of that response decreases and the process is called punishment (see review by Church, 1963; Solomon, 1964; Azrin and Holz, 1966). In addition to these operant effects, shock also has eliciting effects. Shocks that are received by an animal independently of behavior will produce attack against other animals or objects (Ulrich and Azrin, 1962; Azrin, Hutchinson, and Hake, 1963; Azrin, Hutchinson, and Sallery, 1964(*a*); Azrin, Ulrich, Hutchinson, and Norman, 1964*b;* and see recent review by Azrin, 1967). The existence of this "pain-elicited" attack raises important theoretical and applied questions as to whether the usual operant effects of shock will occur if the response being punished is an attack response rather than a response that is not directly elicited by shock. Since shock elicits attack, the use of shock as a punisher might well increase the attacks rather than decrease them, a possibility that has been further considered elsewhere (Azrin and Holz, 1966). This possible facilitation of shock-produced attacks by punishment is also predicted by the "elicited response" type of analysis of punishment, which states that punishment will suppress or facilitate a response depending on whether the punishing stimulus elicits reactions that are compatible or incompatible with the punished response. Evidence for, and discussion of, this theory have been provided by Guthrie (1934), Fowler and Miller (1963), Church (1963), and Sheffield (1949). When shock-elicited attack is punished by shock, the elicited reaction to the shock punisher is of course identical to, and therefore maximally compatible with, the punished attack response. The present study evaluated these theoretical predictions by punishing with shock an attack response that was in itself being produced by shock. A punishment intensity function was obtained to ascertain whether the facilitation occurred only at particularly mild or severe values of punishment.

METHOD

Subjects

Three male squirrel monkeys that weighed 750 to 800 g were maintained under a free-feeding schedule. The monkeys were experimentally naive except that two had been given shocks at varying intensities to determine the intensity needed to produce consistent biting.

Apparatus

The restraining and biting-attack apparatus has been described in detail previously (Hake

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and Azrin, 1963; Hutchinson, Azrin, and Hake, 1966). Briefly, the monkey was loosely restrained in a sitting position within a sound-attenuating chamber facing a pneumatic tube that was mounted on the wall. A transducer attached to the pneumatic tube provided an electrical output to the recording apparatus when the monkey bit the tube. Shock at 60 Hz was delivered from the secondary of a transformer to the monkey by tail electrodes through a 10K ohm resistor. Each shock was delivered for 0.25 sec.

Procedure

All sessions lasted 2 hr and were conducted five days per week. First, the monkey was observed in the experimental chamber for three or four sessions to determine the level of attack in the absence of shock. Then biting attacks were elicited at a high level by delivering a non-dependent shock every 30 sec; shock punishment was not given during this phase, which constituted the No-Punishment Baseline. When punishment was scheduled, a shock was delivered immediately after each bite. A punishment intensity function was obtained by using punishment intensities of 25, 50, 100, and 200 v corresponding roughly to current readings of 1, 2.5, 5, and 10 mA; the non-dependent shocks were always 200 v (10 mA). The complete sequence of procedures was: (1) No-Shock Baseline: neither non-dependent shocks nor dependent shock punishment, (2) No-Punishment Baseline: non-dependent shocks but no shock punishment for biting, (3) 10-mA Punishment: non-dependent shocks plus a 10-mA shock for each bite, (4) No-Punishment Baseline: non-dependent shocks only, (5) 5-mA Punishment: non-dependent shocks plus a 5-mA shock for each bite, (6) No-Punishment Baseline: non-dependent shocks only, (7) 2.5-mA Punishment: non-dependent shocks plus a 2.5-mA shock for each bite, (8) 1-mA Punishment: non-dependent shocks plus a 1-mA shock for each bite, (9) No-Punishment Baseline: non-dependent shocks only, (10) 1-mA Punishment: non-dependent shocks plus a 1-mA shock for each bite, (11) No-Punishment Baseline: non-dependent shocks only. This experimental design permitted the effect of each punishment intensity to be evaluated against an immediately preceding baseline of no-punishment as well as providing a redetermination of punishment value.

Seven to 10 sessions were given at each of the above phases, except that the initial No-Shock Baseline had three or four sessions. One monkey (M-3) received only three sessions during Phase 9 and was discontinued thereafter because of ill health.

RESULTS

During the No-Shock Baseline, each monkey bit less on each succeeding session such that by the last session, M-3 made about three bites per minute and M-1 and M-2 made fewer than 0.2 bites per minute.

Analysis of the data in terms of the absolute number of bites (not in the figure) showed a mean of 9 to 22 bites per non-dependent shock during the various no-punishment periods for each of the monkeys. A gradual decrease in biting was observed within sessions during these no-punishment sessions, as has been described in detail previously for rats (Azrin, Rubin, and Hutchinson, 1968). Session-to-session changes in biting within any of the seven-session periods were slight or inconsistent, but a general increase over time was evidenced by the increase in biting during successive No-Punishment Baselines. Biting was 140, 130, and 120% greater during the last No-Punishment Baseline relative to the first one for the three different monkeys. Hutchinson, Renfrew, and Young (in press) and Ulrich, Wolfe, and Dulaney (1969) have described this same long-term increase over weeks of shock-elicited attacks by monkeys.

Figure 1 shows the effect of the different intensities of punishment on biting attacks. Since the number of bites per session had increased during successive No-Punishment Baselines, the number of bites at each intensity is expressed as a percentage of the number of bites made during the No-Punishment Baseline that most closely preceded or followed that intensity: each point is the mean of seven sessions except for the two determinations at 1 mA (14 sessions) for M-1 and M-2; M-3 had only one determination at 1 mA. All three monkeys made fewer bites as the shock punishment intensity increased. The lowest punishment intensity of 1 mA increased the biting slightly for one monkey (M-1) but not for the other two. At the highest punishment intensity, the shock punishment for biting was equal to the intensity of the non-dependent shock, namely 10 mA. At this intensity, biting was reduced by more than 90%. The redeterminations at 1 mA differed by less than 15% from the original determinations.

Examination of the cumulative response records showed that biting occurred during the period immediately following a non-dependent shock. This temporal patterning has previously been described in detail (Azrin, *et al.*, 1964*a;* Azrin, Hutchinson, and Hake, 1967; Hutchinson, *et al.*, 1966).

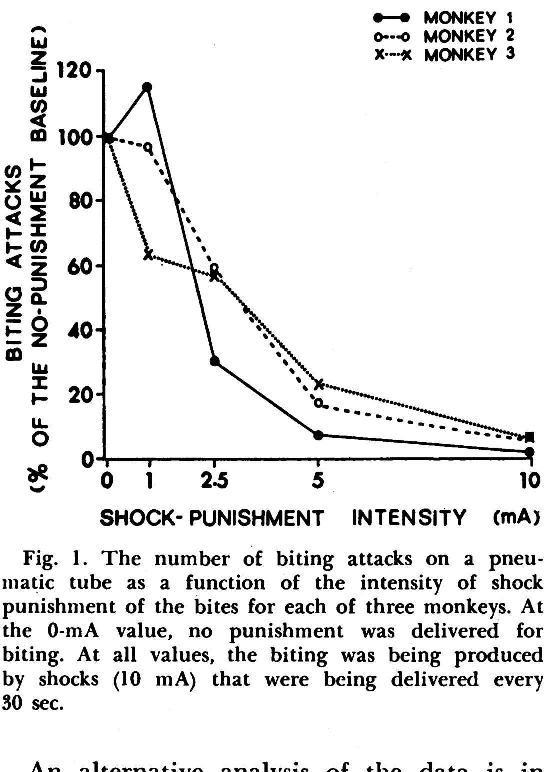

Fig. 1. The number of biting attacks on a pneumatic tube as a function of the intensity of shock punishment of the bites for each of three monkeys. At the 0-mA value, no punishment was delivered for biting. At all values, the biting was being produced by shocks (10 mA) that were being delivered every 30 sec.

An alternative analysis of the data is in terms of the probability that shock will produce attack, probability being calculated as the proportion of non-dependent shock deliveries that resulted in one or more bites (Azrin *et al.*, 1964*b*). For each of the three monkeys, the probability of biting upon shock delivery was greater than 0.95 during the no-punishment procedure and decreased to 0.03, 0.06, and 0.16 for the three monkeys respectively at the 10-mA punishment intensity. Data presentation based on the probability of biting on a given shock showed the same relationship depicted in Fig. 1, which is based on the mean number of bites per shock corrected for the baseline level.

DISCUSSION

In the absence of any shocks, the biting attacks decreased to a near-zero level. When shocks were delivered only on a non-dependent basis during the No-Punishment Periods, the biting attacks increased greatly in frequency and occurred immediately upon each shock delivery. These two findings replicate previous results with monkeys that have been described in detail in Azrin *et al.* (1967) and Azrin *et al.* (1964*a*) and demonstrate that the biting attacks were elicited almost entirely by the non-dependent shocks.

The shocks delivered immediately after each bite during the Punishment Periods did not increase biting at any of the punishment intensities. Rather, the biting was suppressed and to an extent that was a direct function of the shock intensity, as has been found previously for learned and non-aggressive responses. [See review by Azrin and Holz (1966).] This suppression of attack behavior by punishment has also been obtained (Myer, 1966, 1967, 1968; Myer and Baenninger, 1966) for rats during punishment of naturally occurring attacks and of attacks elicited by a tail pinch (Baenninger and Grossman, 1969). Similarly, Adler and Hogan (1963) found that punishment suppressed the natural aggressive display between male Siamese fighting fish. Very recently, Ulrich, Wolfe, and Dulaney (1969) also reported suppression by punishment of shock-elicited attacks in a study very similar to the present one. Together, these results indicate that aggression is suppressed by shock punishment irrespective of whether the aggression is elicited by shocks or by more natural events. No support was found for the prediction by the elicited response theory that aggression would be facilitated when the aggression was punished.

In a sense, the present procedure pitted the operant (suppression by punishment) against the eliciting effect of the pain shocks. The same type of opposition had been made in a previous study (Azrin *et al.*, 1967) in which animals could react to a shock by either avoiding it (operant) or by attacking (elicited). The findings were similar in both studies in that the operant effects overrode the elicited ones; the animals escape or avoided the shock rather than attack in the study by Azrin *et al.* (1967) and the attacks were suppressed by the response-dependent shock in the present study. Taken together these findings indicate that shocks produce attack to the extent that the shocks are unavoidable and the attacks are not punished.

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