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Concurrent Punishment of Aggression and Nonpunishment of Aggressive and Nonaggressive Responses

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CONCURRENT PUNISHMENT OF AGGRESSION AND NONPUNISHMENT OF AGGRESSIVE AND NONAGGRESSIVE RESPONSES

by

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INTRODUCTION

Electric shock and other aversive events will induce aggression in a variety of species (Ulrich and Azrin, 1962; Ulrich, 1967, p. 8). Electric shock will also effectively punish aggression induced by shock or tail-pinch. Ulrich, Wolfe, and Dulaney (1969) and Azrin (1970), using squirrel monkeys, punished with tail-shock hose biting induced by tail-shock of a different intensity; Baenninger and Grossman (1969) produced fighting in paired rats with tail-pinch and used foot-shock to suppress it; Roberts and Blase (1971) produced and punished fighting in paired rats with foot-shock. Azrin (1970) and Roberts and Blase (1971) demonstrated that the degree of suppression was directly related to the intensity of the punishing shock.

The effectiveness of shock as a punisher of shock-induced aggression is surprising; because shock itself induces aggression, the additional, punishing shock could be expected to produce still more aggression. Indeed, punishment of food-reinforced bar pressing by squirrel monkeys has been found to induce aggression (Ulrich, Dulaney, Kucera, and Mueller, in preparation). Some facilitative and emotional effects of punishing aggression have been noted. Immediately following the introduction of punishment, two of the three subjects used by Ulrich, Wolfe, and Dulaney (1969) produced a short, initial burst of atypically high-rate biting. Roberts and Blase (1971) mentioned that, although rats engaged in fewer fights when fights were punished, those that did occur were more vigorous. Ulrich, Wolfe, and Dulaney observed anecdotally that monkeys seemed to bite themselves or to freeze in a slumped posture when hose biting was punished; between episodes of unpunished shock-induced biting, the monkeys appeared to be relatively relaxed. Although punishment suppressed hose-biting, it may also have produced other behaviors not measured by the experimental apparatus.

The previous studies that punished aggression provided only a single experimentally measured response. The two experiments presented below each provided an unpunished alternative to the punished aggressive response. Both experiments punished squirrel monkeys with tail-shock for biting a hose. In Experiment I, a second hose was present in the chamber; bites on that hose were not punished. In Experiment II, a response lever was available for nonpunished responding.

In a similar study of nonaggressive behavior, Dunham (1972) concurrently punished rats for drinking and left wheel running unpunished. Dunham found that, when the opportunity to drink was eliminated either by punishment or by removing the drinking tube, time spent running increased. The amount of increase could be predicted from the proportion of time the animal had spent running when both responses were available. That proportion remained constant as the amount of time available was increased by removal of the drinking tube. Thus the amount of time spent performing the unpunished response increased and contrast occurred. Analogous contrast effects could be anticipated in the present experiment.

However, a different result is suggested by an experiment by Powell (1972) that studied behavior similar to shock-induced aggression. Powell obtained shock-induced lever pressing in rats previously given experience with Sidman avoidance. As part of his study of the phenomenon, Powell first trained rats on Sidman avoidance in a chamber with two response levers, one of which had no effect. Responding developed on the effective lever. When effectiveness of the two levers was reversed, responding transferred from the formerly effective lever to the newly effective lever. Surprisingly, when Powell subsequently presented noncontingent shocks, responding was induced only on the lever effective in initial avoidance training. Powell then punished shock-induced responding on this preferred lever. Punishment suppressed responding on the preferred lever, but responding did not transfer to the nonpreferred lever. Because responding resembled shock-induced aggression in its temporal relation to shock and in its increase in frequency as shock-intensity increased, and because many responses involved biting the bar, Powell concluded that responding was closely related to shock-induced aggression.

On a practical level, the experiments presented below test the practicality of punishment as a technique for controlling aggression. If suppression of one aggressive response by punishment results in increases in unpunished aggression, the use of punishment to control aggression becomes questionable. On the other hand, if punishment of aggression produces a concurrent increase in nonaggressive behavior, punishment may be a viable method for redirecting aggression into nonaggressive behavior.

EXPERIMENT I: CONCURRENT PUNISHMENT AND NONPUNISHMENT OF TWO AGGRESSIVE RESPONSES

Method

Subjects

Four mature male squirrel monkeys served as subjects (S's). Three subjects were experimentally naive; S 2 had served previously in a study of the punishment of shock-induced aggression (Ulrich, Wolfe, and Dulaney, 1969). The monkeys were maintained in separate cages, but within sight and hearing of each other. Water was continuously available and a generous ration of Purina Monkey Chow was fed periodically throughout the day.

Apparatus

Subjects were seated in a Plexiglas restraining chair (Hake and Azrin, 1963) equipped with tail-shock electrodes. Two bite hoses, of natural latex tubing with 3/8-inch inner diameter ain 1/8-inch walls, were mounted on opposite walls of the chamber to the right and left of the monkey's face. Biting a hose produced a change in air pressure which, by means of a pressure transducer, caused the contacts of a silent switch to close and record a discrete bite. The assembly was similar to that described previously by Hutchinson, Azrin, and Hake (1966) but with one modification. The hoses were mounted in a semicircular manner, which concealed the metal hose connectors behind the walls and thus out of reach of the subject. Two changes resulted:

first, since the subjects could not bite the hose connectors, all bites on the hose resulted in some air displacement. Second, small punctures that could cause incomplete recording could immediately be detected, since the semi-circular design caused stresses on the hose that produced a large gap.[1]

The subject's tail was immobilized by a tail stock; electric shocks were delivered through two brass electrodes that rested on shaved portions of the tail. Tail resistance was reduced by massaging the areas of the tail that contacted the electrodes with EKG Sol electrode paste. The shocks were delivered through a 50 K ohm resistor in series with the monkey's tail.

The restraining chair was enclosed in a Plexiglas chamber and a sound and light attenuating outer chamber. Masking noise was present in the chamber room at all times. A ventilator fan and a 25-watt light were provided within the chamber. Standard electromechanical programming and recording equipment were located in a nonadjacent room. Responses were recorded both on cumulative records and on counters.

Procedure

For all subjects one-hour sessions were conducted daily. Subjects 2 and 302 were exposed to an initial no-shock baseline phase in which they were placed in the experimental chamber for one hour daily without shock delivery. The ventilating fan and chamber light were on

[1]The author and the laboratory of the Behavior Research and Development Center are indebted to Mr. Jack Orr for the semi-circular hose design.

and bites were recorded. The no-shock phase was followed by a shock-baseline phase, the initial phase for subjects 101 and 209. During shock-baseline sessions, ten shocks were delivered, one every five minutes, independently of the subject's behavior. Sessions did not begin with a shock, and the last ten minutes of each session were shock-free. Each of the noncontingent shocks was 300 V ac and .15 seconds in duration.

After shock baselines were obtained, a punishment phase was introduced. During punishment sessions, the subject received ten noncontingent shocks as usual, and every bite on one of the two hoses was immediately punished with a 600 V ac, .15 second shock. Bites on the second hose were not punished. The hose bitten most frequently at the termination of the shock baseline was chosen as the hose to be associated with punishment. Punishment phases alternated with phases in which punishment was removed and only scheduled, 300 V shocks were delivered. Noncontingent shock and punishing shock parameters remained constant in all phases.

Phases were continued for long periods of time in an attempt to observe long-term effects and to obtain within-subject consistency of behavior. Subject 209 was run for a total of 24 months, S 101 for 19 months, S 302 for 10.5 months, and S 2 for 8 months.

Results

Figures 1 through 4 show the number of bites produced in each session by subjects 101, 209, 302, and 2, respectively.[2] Figure 5 presents sample cumulative records. Clearly punishment of biting one hose confined biting to the second, unpunished hose. The only exception was the final punishment phase of S 302 in which frequency of unpunished biting remained near zero. Numerous malfunctions of the shock timer forced termination of the subject, and the phase could not be extended.

The character of performances and of changes in performances was highly individual. Most commonly, in the literature (Azrin, Rubin, and Hutchinson, 1968; Hutchinson, Azrin, and Hake, 1966) and in the experience of the present investigator, shock produces a short burst of aggression immediately following shock. Such post-shock scallops occurred in the performances of all animals; an example is shown in the first record in Figure 5 (session 10 of S 101). Most sessions shown in Figures 1 through 4 to have low frequencies of biting consisted entirely of post-shock scallops.

Most animals, at some point in the experiment, also developed "take-off" biting, in which they bit throughout the intershock intervals; an example is shown in record b in Figure 5 (session 24 of S 101). Most points in Figures 1 through 4 that show high frequencies

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[2]Subject 101 was a pilot animal whose results were briefly reported by Ulrich, Dulaney, Kucera, and Colasacco (1972) and are included here in greater detail for completeness.

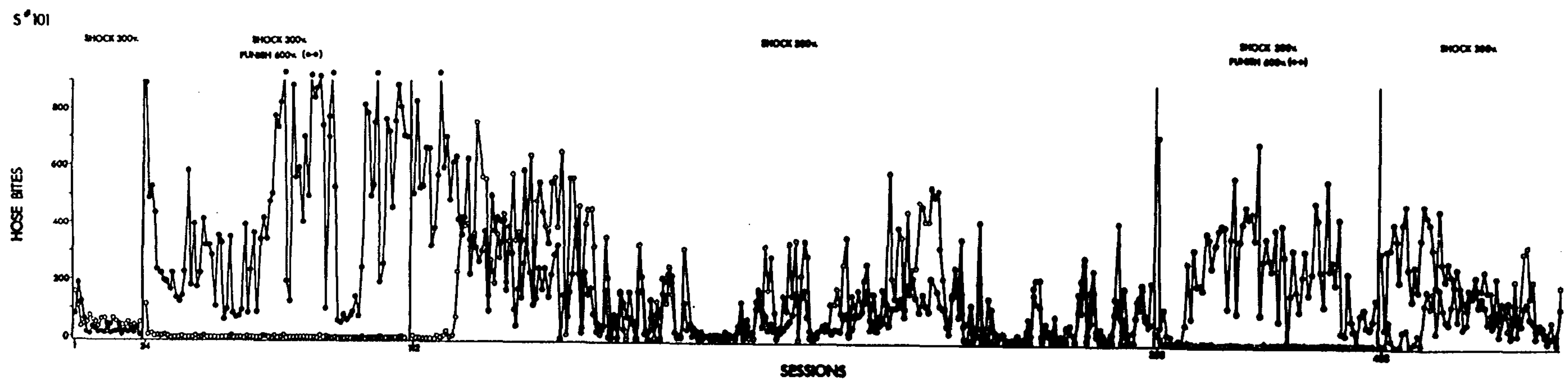

Figure 1. Number of bites on each hose by S 101 in all sessions, all phases. Biting the hose indicated by open circles was punished in both punishment phases.

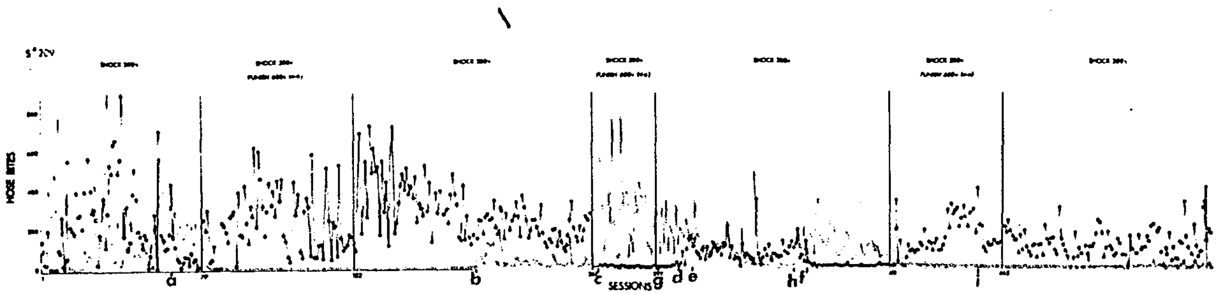

Figure 2. Number of bites on each hose by S 209 in all sessions, all phases. Biting the hose indicated by open circles was punished in the first and third punishment phases; biting the hose indicated by closed circles was punished in the second punishment phase.

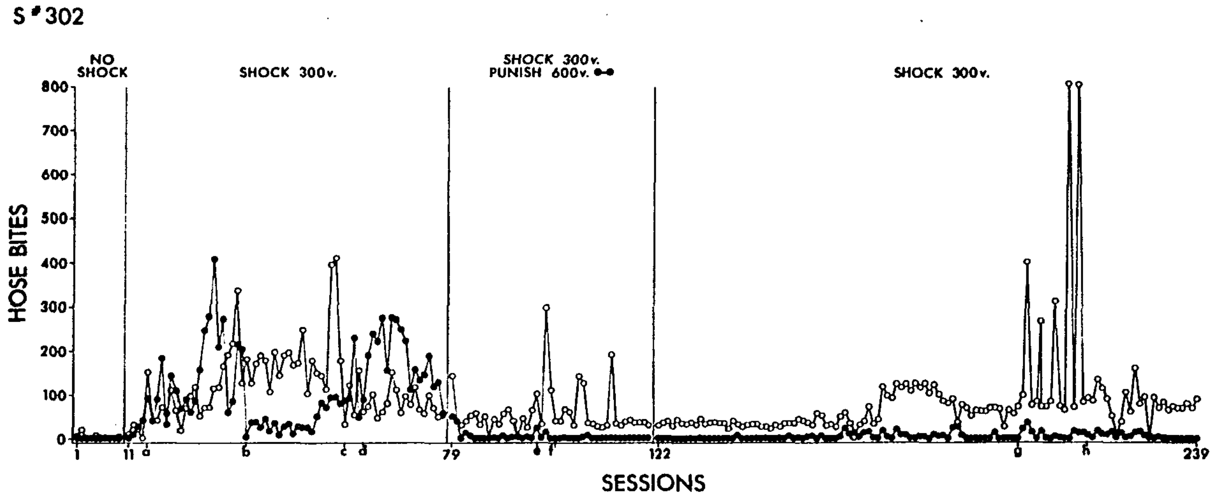

Figure 3. Number of bites on each hose by S 302 in all sessions, all phases. Biting the hose indicated by closed circles was punished in the first punishment phase; biting the hose indicated by open circles was punished in the second punishment phase.

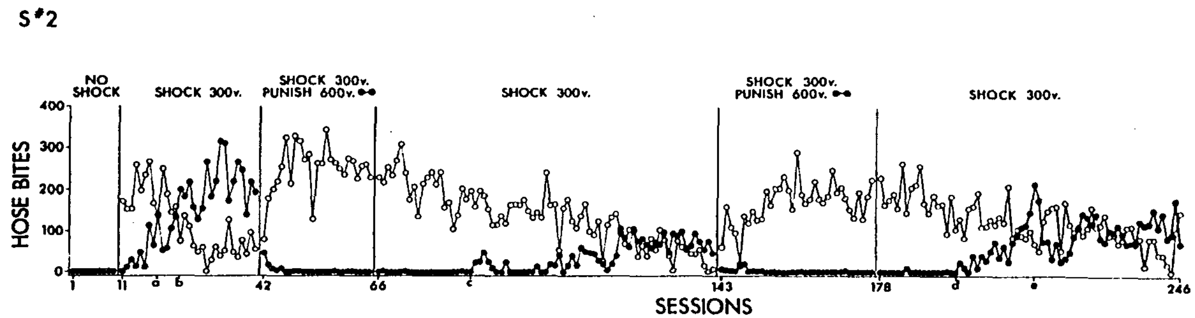

Figure 4. Number of bites on each hose by S 2 in all sessions, all phases. Biting the hose indicated by closed circles was punished in both punishment phases.

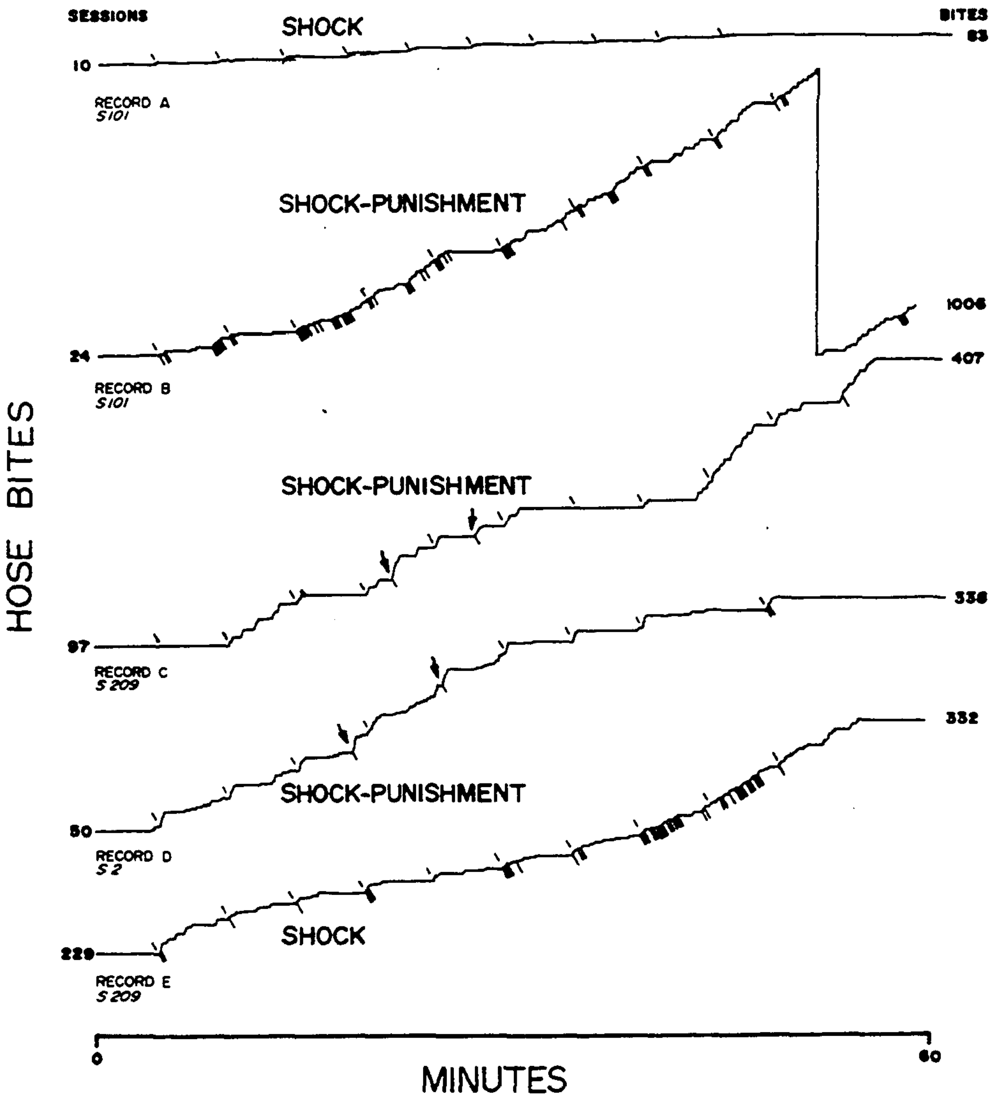

Figure 5. Representative cumulative records. Numbers to the right of records indicate the number of bites produced in the session shown; numbers to the left indicate the session represented by the record. Marks above records indicate scheduled shock; downward displacements of the pen represent bites on the punished or previously punished hose.

of biting correspond to sessions in which take-off occurred during most of the session. Hutchinson, Renfrew, and Young (1971) found take-off performance to be produced by infrequent, high-intensity shocks. In the present experiment, S's 209 and 302 developed take-off performance during shock baseline. Subject 2, whose performance in the current experiment will be discussed below, had developed take-off in the shock-baseline phase of the previous experiment in which it had participated. Subject 101 developed take-off for the first time when punishment was introduced (record b in Figure 5). Take-off performances did not occur consistently, but would fade and reappear by occurring during smaller or greater segments of sessions.

As noted above, S 101 developed take-off for the first time when punishment was introduced. Punishment also changed the performances of the two animals, S's 209 and 302, who had developed take-off during shock baseline. During the first punishment phase, S 209 began biting in sustained bursts following and between shock, pausing between bursts. The development of the performance is shown in record c of Figure 5. Subject 302, during the first punishment phase, began to bite only after shock.

Subject 2, for the greater part of the experiment, produced a combination of post-shock scallops and lower-rate biting that preceded shock. Such anticipatory biting has also been described by previous investigators (Hutchinson and Emley, 1972) and is apparent in record d shown in Figure 5 (of session 50). When, in punishment phases, a punished bite occurred during anticipatory responding, the lower rate was replaced by a burst of high-rate biting; an example appears in record d. Anticipatory biting dropped out of the animal's performance during most of the second punishment phase.

Typically, when punishment was introduced, the animals received a substantial number of punishing shocks during the first session and produced a large number of bites. Biting remained substantial for several sessions, but fewer punishing shocks were received. Subsequently biting usually decreased for a number of sessions, performance consisting entirely of post-shock scallops. Unpunished biting then recovered, usually showing a change from baseline in the character of the performance, as noted above. The decreases in biting frequency several sessions into punishment phases are evident in Figures 1 through 4. An exception is the first punishment phase of S 2. In addition, S 302's biting never recovered from the initial decrease in frequency. With the exception of occasional sudden reappearances of take-off, S 302 produced only post-shock scallops for the remainder of the experiment.

When punishment was removed, previously punished biting usually took many sessions to recover, even when contingencies were sampled early in the phase. In the final punishment-removed phases of S's 209 and 302, previously punished biting never recovered. As previously punished biting did recover, it occurred when previously unpunished biting was also most likely to occur: following shocks, during take-off, or during anticipatory biting, depending on the individual performance of the animal. A typical recovery session, of S 209's session 229, is shown in record e of Figure 5. Also, as previously punished biting recovered, previously unpunished biting decreased in frequency.

Since punished bites were followed by shock, they could be expected to produce post-shock bursts of biting. Indeed, on occasion the animals would bite the punished hose and then turn and produce a burst of unpunished biting. Examples are indicated by arrows on records c and d in Figure 5. However, punished biting was not always followed by unpunished biting. Also, punished biting often occurred when unpunished biting was also likely; any unpunished biting that followed punishment could therefore be expected in any case.

Effects of punishment on frequency of biting

As the experiment progressed the combined frequency of biting both hoses decreased. Figure 6 shows for each animal the mean number of bites per session and per shock computed over each phase. Since in nonpunishment phases ten shocks were delivered, in those phases mean bites per shock equalled one-tenth of mean bites per session. The two scales are equalized in the figure.

A prominent exception to the overall decrease was the first punishment phase of S 101, in which a baseline performance of post-shock scallops changed to a take-off performance during punishment and in all subsequent phases. Nevertheless, in the second punishment phase, S 101's overall frequency decreased, although the character of the performance remained take-off. In every punishment phase, the mean number of bites per shock was less than the mean number of bites per session.

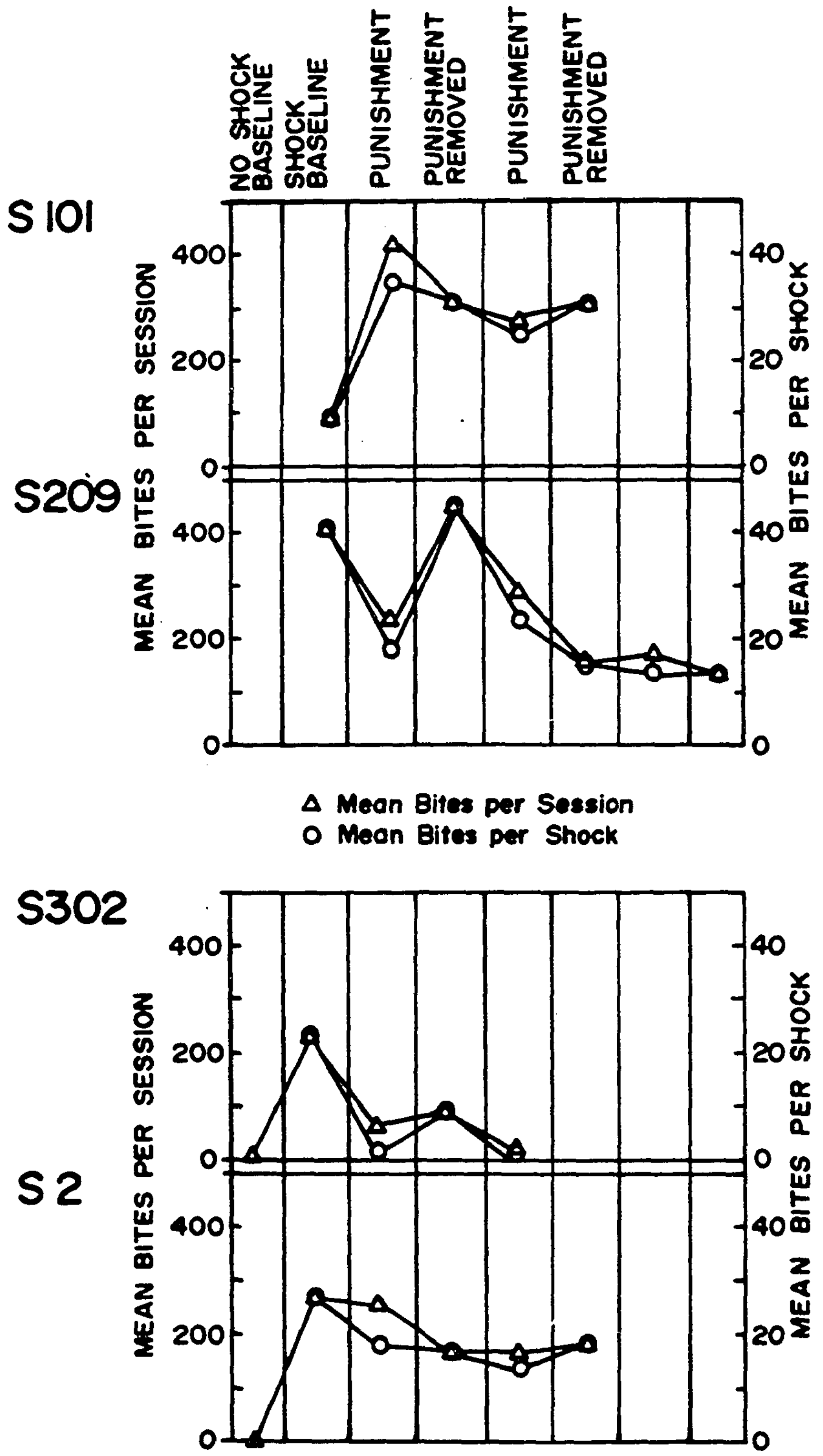

Figure 6. Mean total bites per session (triangles; scale on left axis) and mean total bites per shock (circles; scale on right axis) computed for each subject and each phase.

Effects of punishment on unpunished biting

Figure 7 shows the effect of introducing punishment of one response on the second, concurrently unpunished response. Only ten sessions preceding and fifteen sessions following introduction of punishment are shown; others were deemed too distant in time to be relevant. In all phases of three of the animals, introduction of punishment increased biting on the unpunished hose. Subject 302 was an exception; both responses suppressed or remained suppressed.

Removal of punishment could also have produced an increase either in previously punished biting when compared to its frequency before punishment was introduced or similarly in overall frequency of biting both hoses. However, inspection of Figures 1 through 4 shows that, even when previously punished biting did recover, its frequency did not exceed pre-punishment frequency. The only exception was the first punishment-removed phase of S 101, who continued to exhibit the take-off biting that developed during the first punishment session. The increase was due to the persistence of the higher-rate performance.

Any increase in biting both hoses after punishment was removed would be apparent in Figure 6. As noted earlier, the overall effect of the experimental procedure was to lower the frequency of biting. Although some recovery wometimes occurred in nonpunishment phases, they participated in the downward trend.

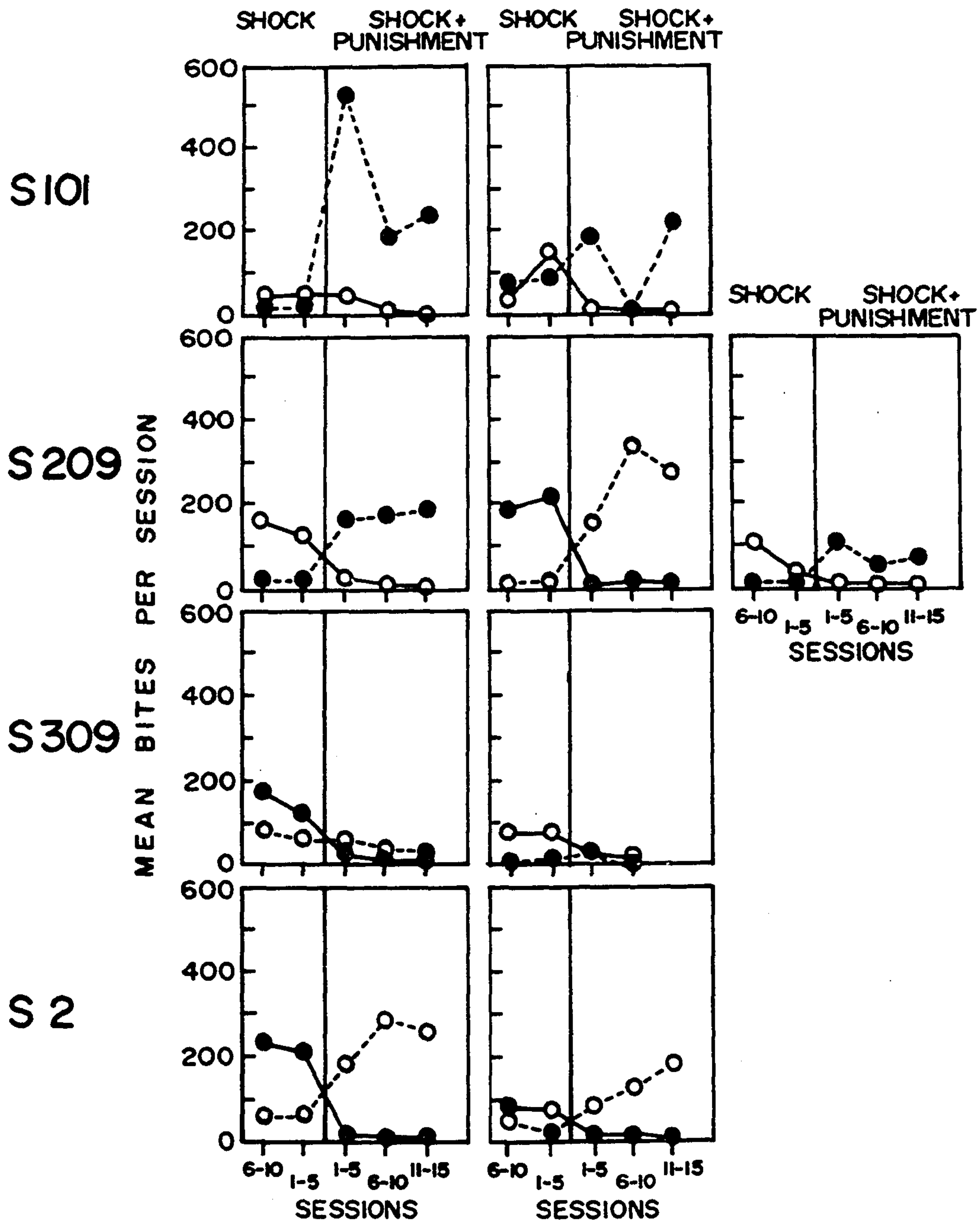

Figure 7. Frequencies per session of biting each of two hoses, averaged over blocks of five sessions. Solid lines indicate the response to be or being punished. Closed and open circles distinguish the two hoses and correspond to the closed and open circles in Figures 1 through 4. Only 10 sessions prior to and 15 sessions (when available) following introduction of punishment were included.

Discussion

When the opportunity for making two aggressive responses was provided and one response was punished, aggression was confined to the unpunished response. Since the frequency of aggression on the unpunished hose generally increased above its pre-punishment level, aggression might be regarded as redirected, or displaced toward that hose. Thus punishment of one aggressive response does not eliminate aggression and may redirect it toward a second object.

The overall effect of the procedure, however, was to lower the frequency of aggression per session and per shock. Because punishment added aversive stimuli to the experimental situation, one would expect an increase in hose biting. Several explanations are possible: First, after a few sessions the animals refrained almost completely from biting the punished hose. Thus the situation was not much different from shock baseline, since they received only the scheduled shocks and had one hose available for unpunished biting. Therefore the number of shocks received was not much greater than during phases when only scheduled shocks were delivered, and a failure of biting to increase is not surprising.

The decrease in responding may have been due to the very intense shock that was used, especially for the punishing shock. Shocks of 600 V were used because they were known to be reliable suppressors of aggression. However, 600 V shock is far more intense than the highest values used in parametric studies of shock intensity and aggression in squirrel monkeys. For example, the highest intensity used by

Hutchinson, Azrin, and Renfrew (1968) and by Hutchinson, Renfrew, and Young (1971) was 400 V. The highest intensity used by Azrin (1970) in a study of the punishment of shock-induced aggression was 200 V. High-intensity shocks delivered noncontingently will decrease ongoing operant behavior (Church, 1969, pp. 132-134). Also, the experiment was run over long periods of time and the animals may have habituated to the shock.[3] In either case, the punishment contingency would not have been critical to the decrease.

A final possibility is that the effects of punishment might have spread from the specific response and specific phases to the second response and to other phases. Such a slow spreading of the effects of a stimulus has not, to the author's knowledge, been reported or studied. Phenomena such as generalization and response induction occur more rapidly.

Bites per shock were even less than bites per session, suggesting that, even when punishment introduced additional aversive stimuli that should have produced aggression, biting did not increase. However, an explanation may lie in one feature of the animals' performances: Scheduled, 300 V shocks occurred singly and were virtually always followed by bursts of biting. However, during punishment sessions, subjects would sometimes produce bursts of punished biting, which would result in bursts of 600 V shocks. The 600 V shocks that appeared in a burst had no opportunity to produce an immediate burst of unpunished biting as did shocks that occurred singly. Thus the

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[3] A possibility suggested by Dr. Galen Alessi.

number of shocks received could substantially increase without a concomitant increase in biting.[4]

Although the procedure lowered the overall frequency of aggression, some transient increases did occur that could be ascribed to punishment. Subject 101 may never have developed take-off performance or may have developed it much later, had punishment not been introduced. Thus punishment may have produced a marked increase in that subject's biting. Also, occasionally a punished bite would be followed by a burst of unpunished biting that probably would not have otherwise occurred. However, most punished bites occurred when unpunished bites were also likely to occur; in such cases, the unpunished biting cannot be attributed to the punishing shock. Furthermore, punished bites were sometimes followed by other punished bites or by pauses in biting.

Punishment usually changed the character of the animal's performance. In the case of S 101, as already noted, post-shock biting was replaced by take-off biting and overall frequency was greatly elevated. On the other hand, S 302's take-off biting during shock baseline was replaced during punishment by post-shock biting. That subject's overall frequency therefore was greatly lowered. During punishment S 209 developed sustained post-shock bursts of responding and S 2 lost for a time its anticipatory responding. Large changes in frequency of aggression after the introduction of punishment were endemic to changes in the character of performance.

In most cases, when punishment was introduced responding remained

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[4]This explanation was first suggested by Sylvia Dulaney and James Scherrer.

substantial for several sessions. Several sessions of low-frequency biting then ensued, followed in turn by recovery of unpunished biting. The sequence in which both behaviors suppress and the unpunished behavior recovers is consistent with the punishment literature which shows, in studies of alternating punishment and nonpunishment of operant behavior in pigeons, that both behaviors initially suppress and unpunished behavior later recovers (Azrin and Holz, 1966, p. 417). What is unusual is the persistence of the unpunished and even the punished behavior through three or four one-hour sessions. Azrin and Holz report suppression of both behaviors in pigeons following one, one-hour session. Savage (1974), using the same apparatus with a single bite hose and shock parameters identical to those used here, punished and left unpunished hose biting in alternating one-minute periods. He obtained suppression in both periods after one session in one animal and after three sessions in another animal. Unpunished biting did not recover in either animal until the punishment phase was terminated, a punishment-removed phase interposed, and punishment reintroduced. A third animal mastered the discrimination in one session. Thus, one of Savage's animals was also slow to suppress. Two of his animals showed the failure of unpunished biting to recover shown by S 302 in the present experiment. Possibly shock-induced aggression is slower to respond to punishment than food-maintained operant behavior.

Obviously the results obtained in the present experiment are far different from the persistent responding on one of two operanda obtained by Powell (1972). The monkeys showed no clear preference for one hose and readily transferred responding to the unpunished hose. Perhaps the monkeys' lack of avoidance history was critical. Or perhaps the shock-induced responses studied in Powell's and in the present investigation are quite different. Powell's response (in the absence of punishment) attenuated over sessions and, especially when noncontingent shocks were relatively infrequent, required occasional doses of avoidance sessions to restore responding. In contrast, shock-induced aggression is extremely persistent and is effectively induced by infrequent shocks (Hutchinson, Renfrew, and Young, 1971). Important differences therefore exist between the response obtained by Powell and shock-induced aggression.

In the present experiment suppression of punished responding was accompanied by increases in unpunished responding. Also, when punishment was removed, previously unpunished biting decreased as previously punished biting recovered. Thus the frequency of one behavior was to an extent inversely correlated with the frequency of the second. However, because of drastic changes in the character of performances, nothing approaching the behavioral regularity obtained by Dunham (1972) was achieved.

Take-off performances did not develop as consistently or remain as consistently in the animals' repertoires as previously reported by Hutchinson, Renfrew, and Young (1971). However, Hutchinson et al. used 400 V shocks that occurred every 4 minutes; the present experiment used 300 V shocks delivered every 5 minutes and, during punishment phases, 600 V shocks that occurred irregularly. Perhaps these parametric differences were critical.

In summary, intense, response-contingent shock, as in earlier studies, suppressed shock-induced biting. Unpunished responding increased after introduction of punishment, but removal of punishment did not increase frequency of biting above pre-punishment levels. As the experiment progressed over extended periods of time, an overall decrease in frequency occurred in all subjects. However, initially hose-biting was more resistant to punishment than operant responses commonly used in studies of punishment, and occasionally a punished response would produce a burst of unpunished responding. In one animal introduction of punishment coincided with the development of high-rate take-off performance and a substantial increase in aggression.

EXPERIMENT II: CONCURRENT PUNISHMENT OF HOSE BITING AND NONPUNISHMENT OF LEVER PRESSING

Introduction

When, in Experiment I, biting on one hose was punished, biting typically increased on the second, unpunished hose. Possibly the increase in unpunished biting represented, not redirected, or displaced aggression, but simply displaced activity. Indeed, Johnson (1972, pp. 37-40) has argued that shock-induced aggression is not necessarily aggression at all, but simply disruption of behavior produced by artificial aversive stimulation. Presumably the disruption could be manifested in nonaggressive as easily as aggressive behavior. Experiment II, like Experiment I, punished biting of a hose. However, Experiment II provided as an alternative response a lever which the monkey could press. If hose biting and lever pressing were indeed interchangable, lever pressing should, first, occur in response to shock, and, second, increase when an alternative response, hose biting, is punished. Furthermore, if punishment can redirect hose biting into lever pressing, punishment would appear to be a viable technique for controlling aggression by redirecting it into nonaggressive behavior.

Method

Subjects

Two mature male squirrel monkeys served as subjects. They were housed and maintained as described in Experiment I. Subject 2 had served in Experiment I and displayed an increase in unpunished biting when punishment for biting one hose was introduced. Subject 3 had served in a previously reported study of the punishment of aggression (Ulrich, Wolfe, and Dulaney, 1969). In that study, S 3 had bitten the hose in response to shock at a low-to-moderate rate before punishment was introduced, stopped biting during punishment, and resumed biting, at a higher frequency, when punishment was removed. Throughout S 3's performance consisted of post-shock scallops.

Apparatus

Apparatus similar to that described in Experiment I was used. However, only one hose was mounted in the chamber, directly in front of the subject's face. A wedge-shaped response lever was mounted parallel to the same wall, below and to the right of the hose, within easy reach of the subject's hand.

Procedure

Shock parameters and schedules were identical to those used in Experiment I. Ten, 300 V shocks were used to induce aggression, and hose biting was punished with 600 V shocks. However, sessions were 70 minutes long; the first 300 V shock was delivered 10 minutes after the session began and a 15 minute shock-free period terminated each session. Both animals were run for a number of sessions of scheduled shock only (the shock-baseline phase), a number of sessions in which hose biting was punished (the punishment phase), and a number of sessions in which punishment was discontinued (the punishment-removed phase). Subject 3 also underwent an initial no-shock baseline phase, as described in Experiment I.

Results

Figures 8 and 9 show for subjects 3 and 2, respectively, the number of bites and lever presses produced in each session of Experiment II. Both subjects pressed the lever at low rates in all phases of the experiment. During S 3's no-shock baseline a close correspondence is evident between number of bites and lever presses. This correspondence disappears during shock baseline, when biting increased and bar pressing did not. When punishment was introduced, S 3's frequency of biting decreased, but its frequency of bar pressing did not change. When punishment was removed, S 3's biting recovered to a high frequency; frequency of bar pressing remained low. Some correspondence may occur in this last phase between relative frequencies of biting and bar pressing; some peaks correspond and pressing shows an increase concomitant with biting.

During shock baseline S 2 produced the very high rates of biting typical of take-off performance. Lever pressing remained low, although some days with relatively high rates did correspond. When punishment was introduced, biting suppressed to very low frequencies; lever pressing also suppressed, although more slowly. When punishment was removed, S 2's biting recovered to high frequencies, but lever pressing did not change. No correspondence in relative frequencies is apparent in the punishment or the punishment-removed phase. Unfortunately cumulative records of lever pressing were not obtained and information was not available on the distribution of lever presses within sessions.

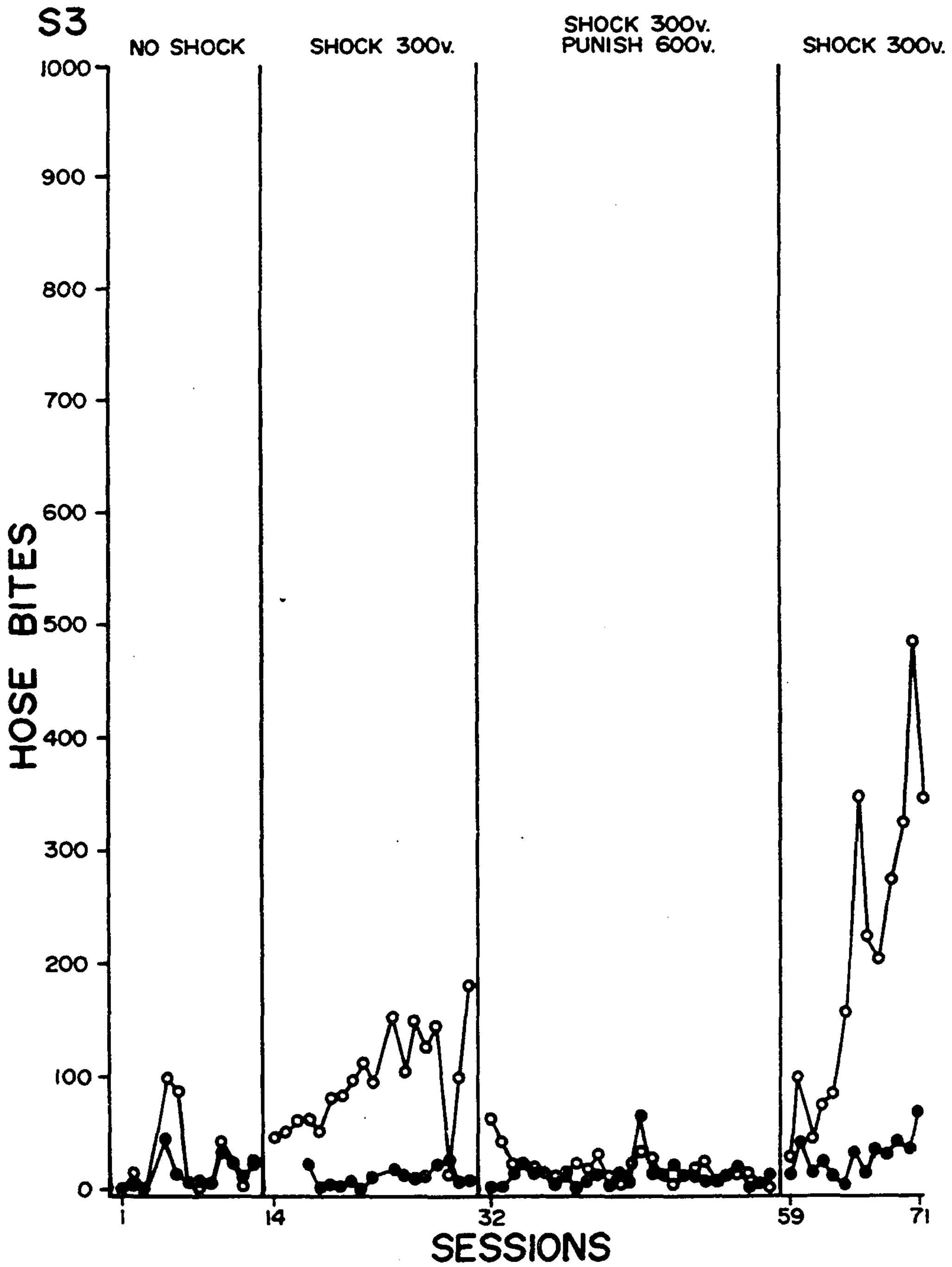

Figure 8. Number of bites (open circles) and lever presses (closed circles) produced in each session by Subject 3.

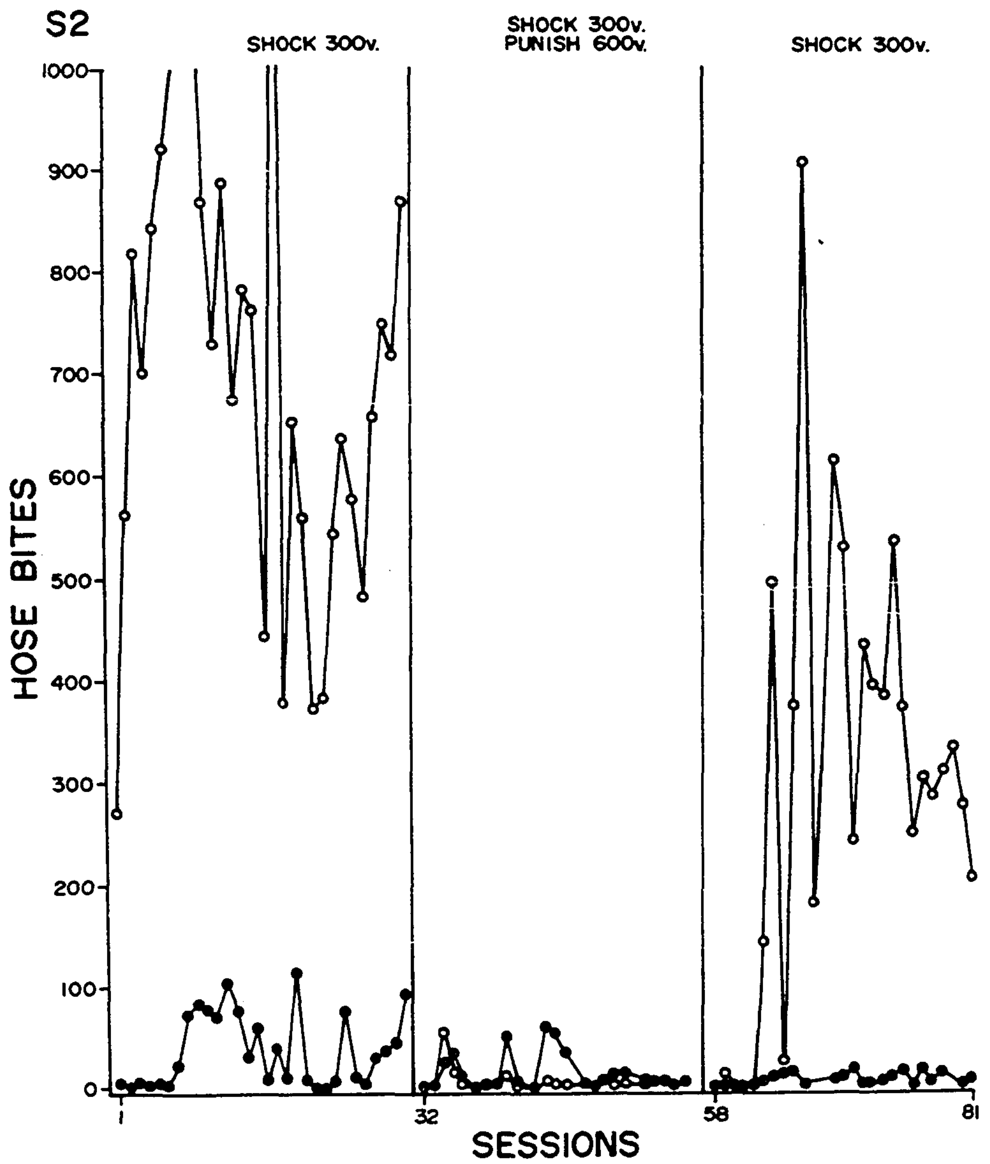

Figure 9. Number of bites (open circles) and lever presses (closed circles) produced in each session by Subject 2.

Discussion

Clearly lever pressing did not behave as did hose biting in Experiment I. Rates of lever pressing were consistently lower during shock-baseline phases, and did not increase when biting was punished. Although the results may be mitigated by the subjects' long experience with the bite hose and relative inexperience with the response lever, the experiment was conducted over periods of from three to six months, giving ample opportunity for shock-induced lever pressing to develop. Indeed, the punishment of the alternative, biting response to shock should have produced development of shock-induced lever pressing. The fact that lever pressing did occur from the beginnings of both animals' performances, and that, indeed, rates of lever pressing and hose biting were equal during a no-shock baseline, suggests that both responses could readily have occurred. Biting was a far more probable response to shock. Punishment of biting did not result in displacement of activity to another, nonaggressive response.

IMPLICATIONS

In an actuarial sense, the results of Experiment I may suggest that punishment has some value in controlling aggression: the punished response invariably decreased to near-zero levels and over the long term the procedure produced a slight decrease in aggression. However, aggression, because of its destructiveness, is an unusually undesirable behavior and any increases produced by a given procedure should be taken seriously. In most cases, the decrease in the punished aggressive response was accompanied by an increase in a second aggressive response. The net gain or loss depends on the relative destructiveness of the two behaviors, but the likelihood of punishment redirecting aggression into other equally or more destructive behavior should be taken into account.

Punishment also produced unpredictable changes in the character of the animals' aggressive performances. Transient increases in aggression occurred when occasionally an animal would emit a punished bite and receive a 600 V shock. Aggression was more resistant to punishment when first introduced than is the operant behavior used in most studies of punishment. Thus changes produced by punishment of aggression are not as immediate, predictable, or permanent as one would like.

The best possible use of punishment would be to redirect aggressive into nonaggressive behavior. However, the results of Experiment II suggest that aggressive behavior, when punished, does not transfer to other objects that require a nonaggressive topography.

In using the above results to evaluate the possibilities of punishment as a technique for the control of aggression, one must keep in mind the intensity of the shock. Very intense shock can be suppressive, regardless of the contingency; less intense punishment could conceivably produce facilitative effects not found in the present experiments. Further work, especially at lower intensities, is needed before punishment can be concluded to be an effective or desirable procedure for the control of aggression.

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