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Conditioned Punishment of Self-Injurious Behavior

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CONDITIONED PUNISHMENT OF SELF-INJURIOUS BEHAVIOR

by

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INTRODUCTION

Behavior which consistently results in self-injury is not uncommon in severely retarded, institutionalized children. At Fort Custer State Home approximately 40 such cases out of a population of roughly 1,000 patients of all ages have been referred to the psychology staff. While some residents bite their lips or pick their cuticles a few times a day, other individuals exhibit a variety of complex responses such as headbanging, kicking, poking themselves and beating themselves with their fists. Summed, the responses in an individual might reach several hundred per minute. Many of these persons have spent years in restraints, which, although preventing self-injury, have impeded the development of normal motor skills and related social and intellectual behavior. Some children have severely and permanently damaged themselves.

One of the recently tested procedures for eliminating self-injurious behavior is extinction. Under this procedure, the rewarding consequences (reinforcement) of the behavior are removed. In one case (Bucher and Lovaas, 1967) the self-injurious behavior of a child had, in the past, been immediately reinforced by attendants rushing to his side. His behavior seemed unmitigated, although doctors reported that he was a careful hitter and had never seriously damaged himself. Extinction treatment consisted of removing the social consequences of the undesirable behavior.

The child was simply left alone in bed without restraints. The frequency of self-injurious behavior fell from 3,000 responses in 90 minutes on the first day, to 15 responses in 90 minutes on the eighth day. Unfortunately, he still hit himself when out of the bed.

This procedure could not be used with many children because of the potential danger of permanent damage. Allowing as much as 50 responses of some types such as eye poking could cause the loss of major anatomy or even be fatal. Furthermore, the treatment takes time and has no particular advantages over other procedures.

Another technique for eliminating behavior is the reinforcement of incompatible responses. If the child is doing manual work, or playing with toys, for example, it is difficult to hit himself at the same time. However, in order to reinforce incompatible behavior, it is necessary to first stop self-injury long enough so that other behaviors can be emitted and reinforced.

Whaley and Tough (1968) trained a boy to first escape and later to avoid shock by placing his hand on a specific toy. Soon the child spent long hours clutching the toy. Later several toys were substituted for the one toy. The behavior of playing with the toys was incompatible with self-injurious behavior, and the child could spend several hours a day out of restraints. Playing with the toys also increased his manual dexterity.

However, the most widely used technique has been punishment (Bucher and Lovaas, 1967; Hitzing and Risley, 1967; Lovaas, Freitag, Gold and Kassorla, 1965; Lovaas, Schaffer and Simons, 1965; Risley, 1968; Whaley and Tough, 1968; and Wolf, Risley and Mees, 1964). In the above studies every time the child hit himself, an electric shock was applied immediately following the response. The harmless electrical stimulation quickly and effectively suppressed self-injurious behavior.

Unfortunately most of the subjects in the above studies formed rapid discriminations of the presence or absence of punishing personnel. When the experimenters were absent, self-injurious behavior quickly returned to its former rate. (For a more extensive discussion of punishment generalization, see Birnbrauer, 1968.)

In the natural setting relatively few primary aversive stimuli need occur, because primary stimuli are intermittently paired with conditioned stimuli. A loud "no" from a child's mother often brings a sharp halt to the behavior which preceded it. Of course, the "no" must be paired from time to time with a spanking or similar aversive event or it loses its effectiveness.

This paper focuses on the phenomenon of conditioned punishment. It reports a study designed to determine if a buzzer can become an effective conditioned punisher of self-injurious behavior by being paired intermittently with shock.

METHOD

Subject

One thirteen-year-old boy served as subject. He was diagnosed by the hospital as "mentally retarded, cause unknown . . . with secondary cataracts in both eyes . . . slightly verbal . . . not toilet trained . . . highly self-injurious." A variety of therapies to stop self-injury had been attempted with no lasting effect.

The subject's primary self-injurious response consisted of striking his nose, eye, or forehead with a tightly clenched fist. Each contact was considered one response. This response was so consistent that the observer had no difficulty distinguishing it. A check on recording reliability by an independent observer varied less than five per cent from the experimenter's observations. Intermittent self-kicking, head-banging and beating himself about the legs were also noticed. However, these responses seemed much less injurious than the self-hitting response, and they did not occur as frequently.

The subject was maintained in a semi-isolated room for a period of over two months while several descriptive studies and experimental treatments were conducted. Access to the room was limited to hospital personnel who had responsibility for his care and to the experimenter. He was watched from the adjoining room through a one-way mirror. He

was restrained to prevent inflicted injury except for brief periods when his diaper was changed, when he was bathed or when baseline data were taken to see how often he would hit himself.

Primarily two types of restraints were used to prevent these self-injurious blows. One type consisted of two stiff plastic sleeves which allowed limited hand and arm use but prevented the elbow from being bent. However, because he sometimes hit himself in the legs and hips with the plastic restraints, a jacket-type of restraint was used in addition to the plastic sleeves. The subject regularly flexed against the restraints and sometimes ripped the double-stitched seams of his jacket and slipped out. Loud crying generally followed his escape and then stopped either when his restraints were put back on or when he began hitting himself.

Apparatus

Responses were recorded by a hand-operated microswitch on electro-mechanical counters and on a cumulative recorder.

The shock was a 2 ma pulsating-DC current delivered through a pair of snap leads attached above the subject's right ankle. A switched voltage meter allowed regular checks to determine that the voltage from the source remained constant. The battery was recharged as necessary.

The subject's room (Appendix A) contained a large crib, a chair for the experimenter, a window to the outside, a one-way mirror, a small table and the treatment chair.

The treatment chair (Appendix B) kept the subject from squirming excessively, prevented his arms from moving below his waist and allowed his arms to be tied down easily. It was a large rocking chair modified in the following ways: It was tilted back, blocked and nailed to the floor so that the seat angled approximately 30 degrees from the floor. The seat and back were padded with a doubled-over quilt, a total thickness of about one inch. A waist-high three-quarter inch tray and waist restraint was attached by four wing nuts to the chair arms. Two wide straps which crossed the subject's chest and a pillow behind his head reduced head-banging. There were also straps for both legs and the left arm.

The right wrist was strapped to a nylon cord which ran through a hole in the waist tray and chair arm and could be secured at the back of the chair. This cord could be adjusted so that the subject's right arm could either be held tight against the waist tray or released to allow approximately two feet of slack--giving the subject enough room to hit himself in the face.

A buzzer was attached to the right of the chair. Buzzer onset and duration could be controlled either manually or automatically through electro-mechanical circuitry. The automatic method was used when the buzzer onset was non-contingent during the pairing sessions.

Observation was aided by a closed circuit television camera in the upper right hand corner of the room.

Procedure

(Refer to the Procedure Chart in Appendix C)

Baseline Sessions

Pre-treatment tests (the first type of test session) of normally occurring self-injurious rates were taken with the subject in the experimental chair. The chest straps and head pillow were positioned, the waist lock attached, the subject's ankles and legs restrained and the electrodes attached to his right ankle. After the subject had quieted, two feet of slack was allowed in the cord tied to his right wrist. The criterion for terminating the session was either the passage of five minutes or skin breakage. Baseline was never taken if there were any open wounds or swelling.

Between sessions, the subject was kept in semi-isolation in his room and observed during all waking hours so that no unusual event which might radically effect the experimental treatment could occur.

After three consecutive sessions of high stable rates, one session was run with the noise of the buzzer contingent upon each response. Because this seemed to have no major effect on the behavior, the following experimental treatment was begun.

Experimental Sessions

Two types of experimental sessions were alternated: 1) pairing sessions where shock was intermittently paired with the buzzer and 2) probe

sessions where the effects of a small number of contingent buzzer presentations upon self-injury were tested.

Non-contingent Pairings. During the pairing sessions, the buzzer and shock were presented. The duration of the buzzer was one second; it was presented, on the average, every 15 seconds (the shortest period between buzzers was 2.5 seconds, the longest 30 seconds). After one-fourth of the buzzers, a one second shock was delivered (the number of buzzer presentations between a buzzer-shock presentation varied from zero to seven). The sessions lasted either long enough to present 40 buzzers and 10 shocks (approximately 10 minutes) or 80 buzzers and 20 shocks (approximately 20 minutes).

Probe Sessions. The probe sessions (the second type of test session) usually followed within one hour of the pairing sessions. They were the same as baseline sessions except that some responses were followed by a buzzer presentation. The microswitch which counted the responses also activated the buzzer if another hand-operated switch was also engaged. After a predetermined number of responses had occurred (10, 20, or 30), the next four consecutive responses were followed by buzzer presentations. Then another series of responses was allowed to occur before the effect of the response-contingent buzzer was tested again. The minor variations in the probe procedure were for the purpose of insuring that any effect was not due to the particular numbers chosen and to reduce the chances that a discrimination might be formed between

the sequence of responses followed by buzzers and those not followed by buzzers. The response-contingent buzzer was never presented more than eight times in any single probe session.

The subject was exposed to 13 non-contingent pairing sessions and 14 probe sessions, over a period of 14 calendar days. By inserting regular probes which would presumably not affect the treatment, quantitative data could be gathered about the cumulative effects of the number of pairings. If, instead, only one test was inserted at the end of a large number of pairings and provided equivocal results, very little knowledge about the pairing procedure would have been gained. Of course, for the probe technique (Sidman, 1960:120-127) to be valuable, it was necessary to assume that the acquired properties of the buzzer would not extinguish during the probe sessions nor would the subject learn to discriminate that no shocks would be received during the probes.

Contingent Pairings. Because the above procedures did not radically reduce self-injury, between test sessions 11 and 12, 10 responses were followed immediately by a short (250 msec) contingent shock-buzzer combination. Also, two responses were followed by a similar shock-buzzer presentation between sessions 19 and 20.

Between sessions 17 and 18, and 18 and 19, the pairings were done with the subject's right arm released. This procedure was tried in order to reduce the

amount of discrimination between pairing and test conditions. The pairings still were not contingent upon the subject's behavior.

Extinction Sessions

The final four sessions were extinction sessions (the third type of test session). The first session lasted 18 minutes and the last three sessions were between 35 and 50 minutes long. The subject's arm was released during the sessions. Several response-contingent buzzers were presented intermittently during these sessions.

RESULTS

Figure one shows the response rates during the sequence of five baseline, 14 probe and four extinction sessions (collectively referred to in the following text as either test sessions or simply sessions). The ordinate is a six cycle log scale which allows highly variable rates to be compared. The points represent the total number of responses observed in a session divided by the total number of seconds which elapsed.

After the first pairing session in which 10 shocks and 40 pairings had been presented, (represented by the first horizontal line in Figure 1), the response rate during the subsequent test session decreased to .24 responses per second (75 responses per 313 seconds). Then the rates gradually rose over sessions to 1.2 responses per second (30 responses per 25 seconds), during session 10. Rate during session 11 dropped to .39 responses per second (30 responses per 77 seconds).

Then, between sessions 11 and 12, each response during a sequence of 10 was followed by a shock-buzzer presentation (the second horizontal line in Figure 1). In the subsequent session, rate dropped to .017 responses per second (27 responses per 1584 seconds).

However, the rate increased over sessions 13 to 17 when a high of 2.2 responses per second (38 responses per 17 seconds) was reported. The rates in sessions 18 and 19 remained above one response per second, even

after two pairing sessions with the subject's right arm free. After session 19, two shock-buzzers were presented contingent on two responses on two distinct occasions (represented by the third horizontal line in Figure 1). During the sessions that followed, response rates dropped to nearly one response per 100 seconds.

Figure 2 shows local rates for sessions five, seven, and nine. These are tracings of actual cumulative records which have been enlarged to twice the actual size. The upper portion shows the high stable baseline of 1.3 responses per second (85 responses per 64 seconds). Each response in this record was followed by a buzzer.

The middle record segment of Figure 2 shows the effect of response-contingent buzzer presentation after 30 pairings of the buzzer with shock. The arrows point to the first response in a sequence of four which is followed by buzzer presentation. At the presentation of the first buzzer, responding ceased and then increased. Responding stopped for an estimated 25 seconds when the first buzzer of the second series was presented.

The lower segment of Figure 2 shows that the buzzer had virtually no effect on self-hitting during session nine. On this record, the response pen was deflected just before the first response-contingent buzzer, and remained deflected through each sequence of buzzer presentations. The pen returned immediately after the last response in the sequence. This record is fairly representative of sessions 8, 9, 10, 11, 14, 15, 17, 18 and 19.

Figure 3 is a linear plot of sessions one through 11. The rise in total response rate from sessions six through 10 is most clearly seen in this plot. Other sessions were not included in this figure because of the increase in variability.

Figure 4 shows that after the pairing of 10 shocks with 10 buzzers, contingent upon the self-injurious behavior, response rate decreased. The pairing was done between sessions 10 and 11. The upper segment (session 10) shows 10 responses followed by 10 response-contingent buzzers and then 10 more responses. During session 11 (the middle segment) the subject made 10 rapid responses before the presentation of the first buzzer. Then the response rate dropped. There were four response-contingent buzzers presented between the first two pen-deflections, followed by a long pause, 10 more responses, and then another response-contingent buzzer presentation. Another response-contingent buzzer occurred, followed first by a long pause and then by another response-contingent buzzer. After this 27th response, there was a pause of approximately nine minutes and then the session was terminated. It should be clear that no shocks occurred during this session.

The lower segment of Figure 4 shows that the decreased responding shown in session 11 had recovered. During session 12, there were 20 responses, four response-contingent buzzers, 20 responses, four response-contingent buzzers, then 10 more responses.

Between sessions 19 and 20, two response-contingent, shock-buzzer presentations occurred. Figure 5 shows the suppressive effect of

response-contingent buzzer presentation. On this record each response-contingent buzzer is shown by a brief deflection of the response pen. Here the buzzers were presented only one at a time so that the behavior would not be totally suppressed. Approximately 14 minutes elapsed between the last response-contingent buzzer and the termination of the session.

Even though there were no more shocks presented at any time after the start of session 20, responding was very low during sessions 20, 21, and 22 (Figure 1). Figure 6 is a tracing of the cumulative record of session 23. During this session, which lasted approximately 45 minutes, over 200 responses were emitted. This indicates that the self-injurious behavior was recovering from a low during session 21 of less than one response per minute. During session 23, contingent buzzer presentations stopped the behavior for short periods.

DISCUSSION

These data suggest that a previously neutral stimulus can become a punishing stimulus by being paired with shock. A buzzer which had no effect on self-injurious behavior was paired with a shock. After many pairings, the buzzer reduced the behavior upon which it was made contingent.

Unfortunately the minimum conditions necessary to produce the conditioned stimulus are not clear. There are several confounding circumstances which have not been effectively separated. The interaction between contingent pairing and non-contingent pairing is not described; the effect of the intermittent pairings is not clear; the minimum number of pairings needed to produce the effect is not determined; the role of discrimination of the punishment situation is not determined; the relationship of punishment and avoidance paradigms in describing the elimination of behavior by use of a conditioned stimulus is confused.

The circumstances causing the above problems are these: The first two non-contingent pairing sessions seemed to have been somewhat effective as demonstrated in session seven (Figure 2). However, by session nine, the buzzer had no effect. A trend can be seen in Figure 3 of increased responding for four consecutive days in spite of the fact that further pairings occurred between all of the sessions. The most plausible speculation is that the subject had learned to discriminate that shock did not follow buzzers during the periods when his hand was free. Other

researchers (Birnbrauer, 1968; Lovaas, 1967; and Risley, 1968) have shown that similar rapid discriminations of punishment situations have occurred. However, this is not an experimentally validated explanation in the present case.

After only two contingent pairings, the buzzer radically decreased the behavior (the lower segment of Figure 5). Here is some reason to suspect that there is an interaction between the number of non-contingent pairings and contingent pairings. If the contingent pairings of the buzzer and shock were the only situations in which conditioning occurred, why was the effect so dramatic as a result of only two contingent pairings between sessions 13 and 20? The most plausible explanation is that some conditioning may have occurred during the non-contingent pairings but that a discrimination was formed because the subject was never shocked during the test sessions. The effects of the non-contingent pairings then interacted with the effects of the contingent pairings to produce the conditioned punishment results seen in Figure 5.

Another problem is that the effects of the intermittent pairings can not be clearly assessed. The purpose of presenting one shock to every four buzzers was to increase resistance to extinction when the buzzer was presented alone. The slight effects seen in sessions five and six (Figures 1, 2 and 3) suggest that this goal may have been achieved to some extent. However, by session nine any effects had clearly been extinguished. This suggests that the probe procedure suggested by Sidman (1960:120-127) is

most effective for stable rates which are maintained by relatively intermittent consequences. The variable ratio of one shock to four buzzers does not seem to be intermittent enough for the procedure used here.

Finally, the buzzer did reduce behavior upon which it was made contingent (Figures 5 and 6), which shows that formerly neutral stimuli can become conditioned punishers of self-injurious behavior.

This report seems to be the first investigation of self-injurious behavior which has utilized such extensive observation and control of outside circumstances. The subject was isolated and observed for over two months. It seems unlikely that such things as "bootleg reinforcement" (Ayllon and Michael, 1959) were affecting the behavior. This author speculates that the variability in responding which seems anomalous is probably due to histori variables rather than immediate ones.

FIGURES

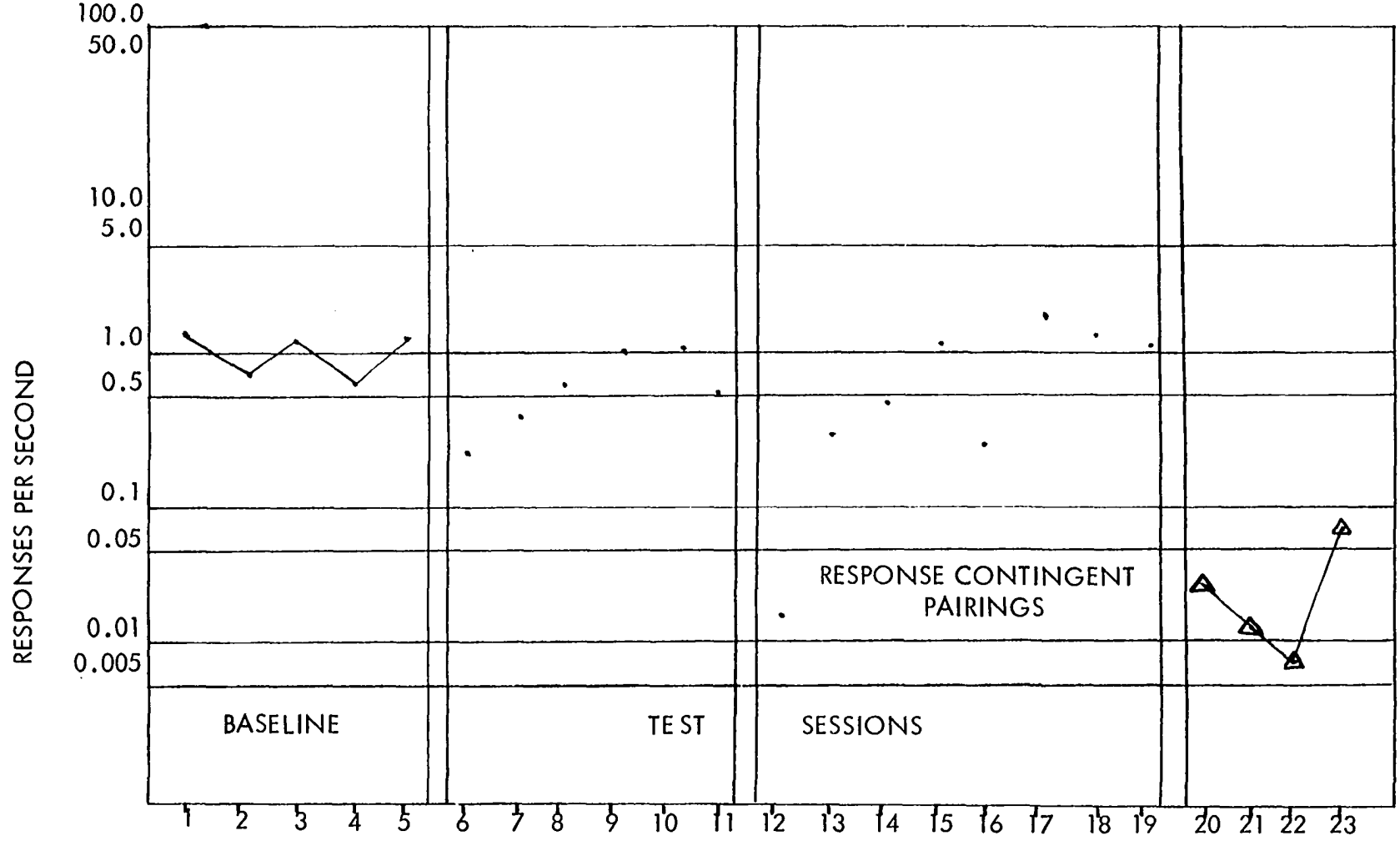


Figure 1. Self-injurious responses on a six cycle log scale

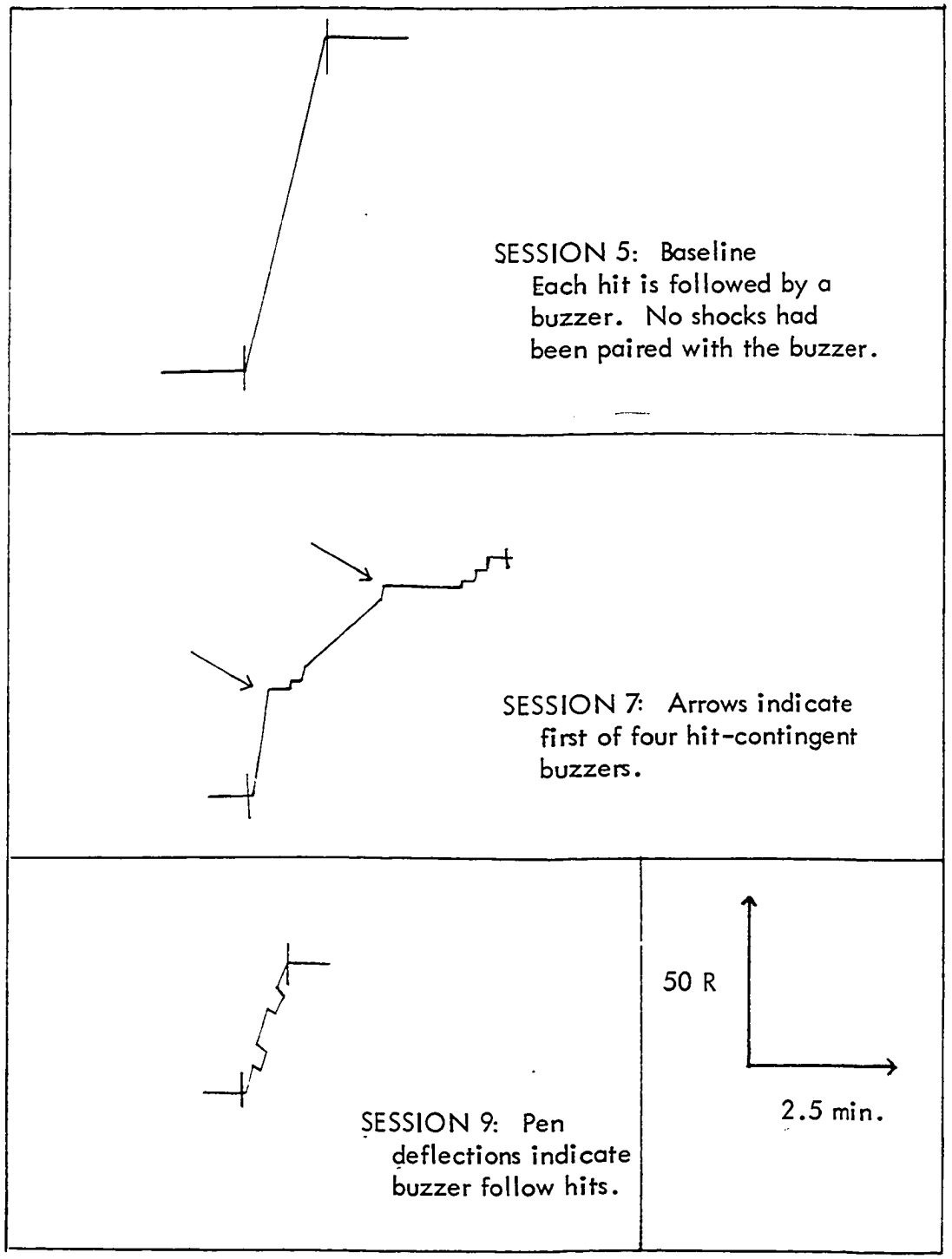


Figure 2. Cumulative records of self-injurious responding. The middle tracing shows the punishing effect of the buzzer.

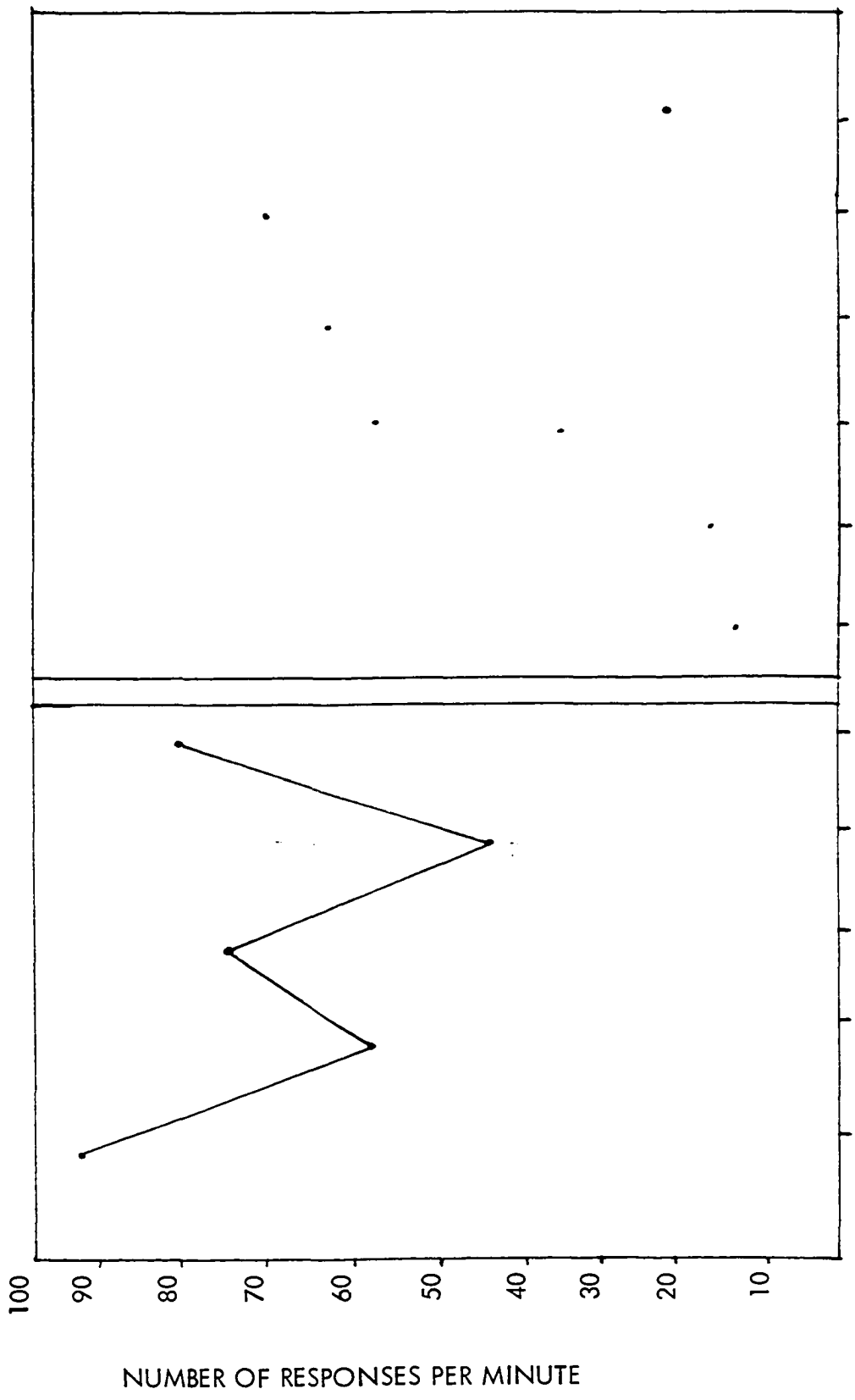


Figure 3. Self-injurious responses on an interval scale

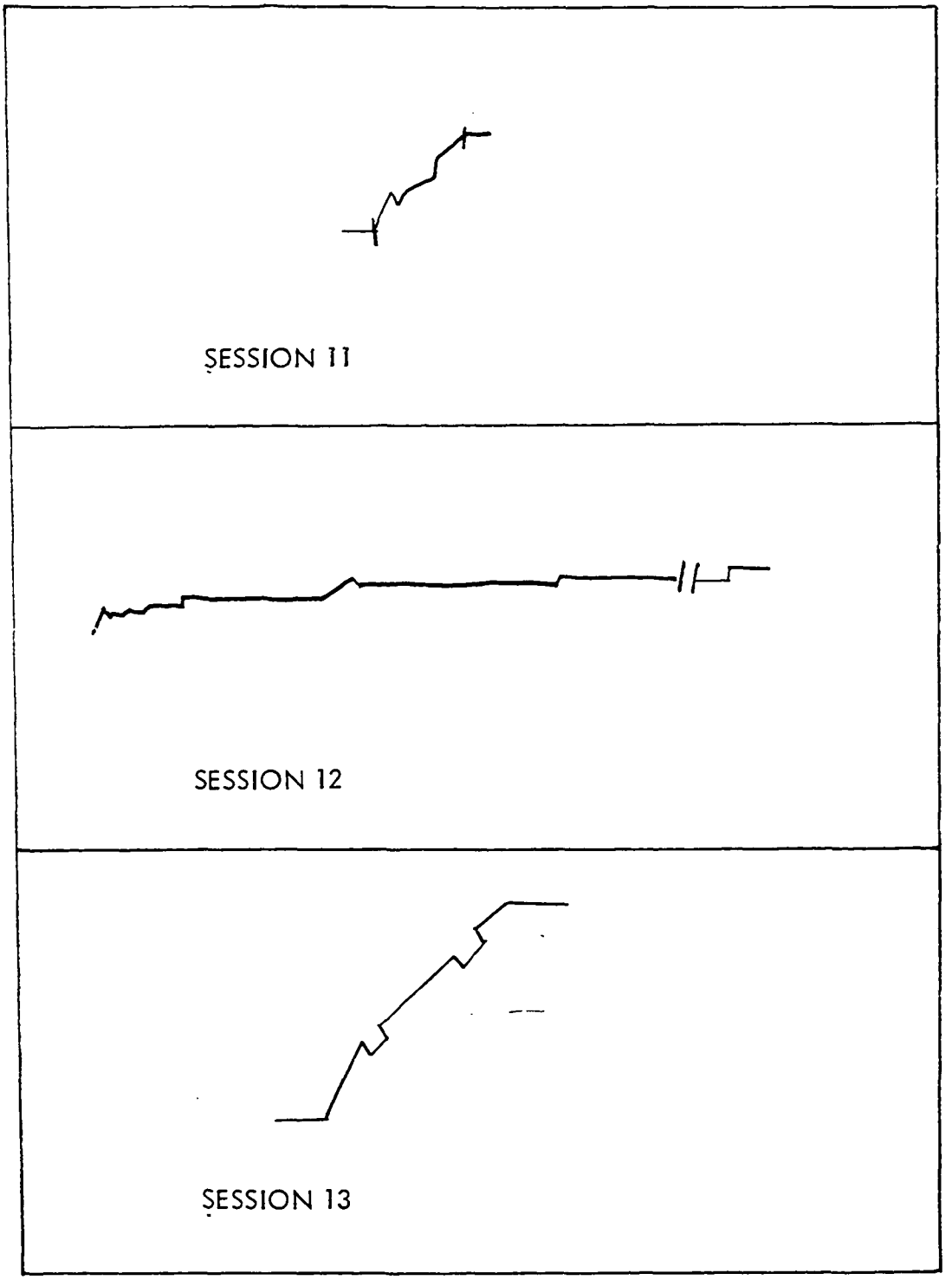


Figure 4. The effects of contingent pairing upon self-injurious response

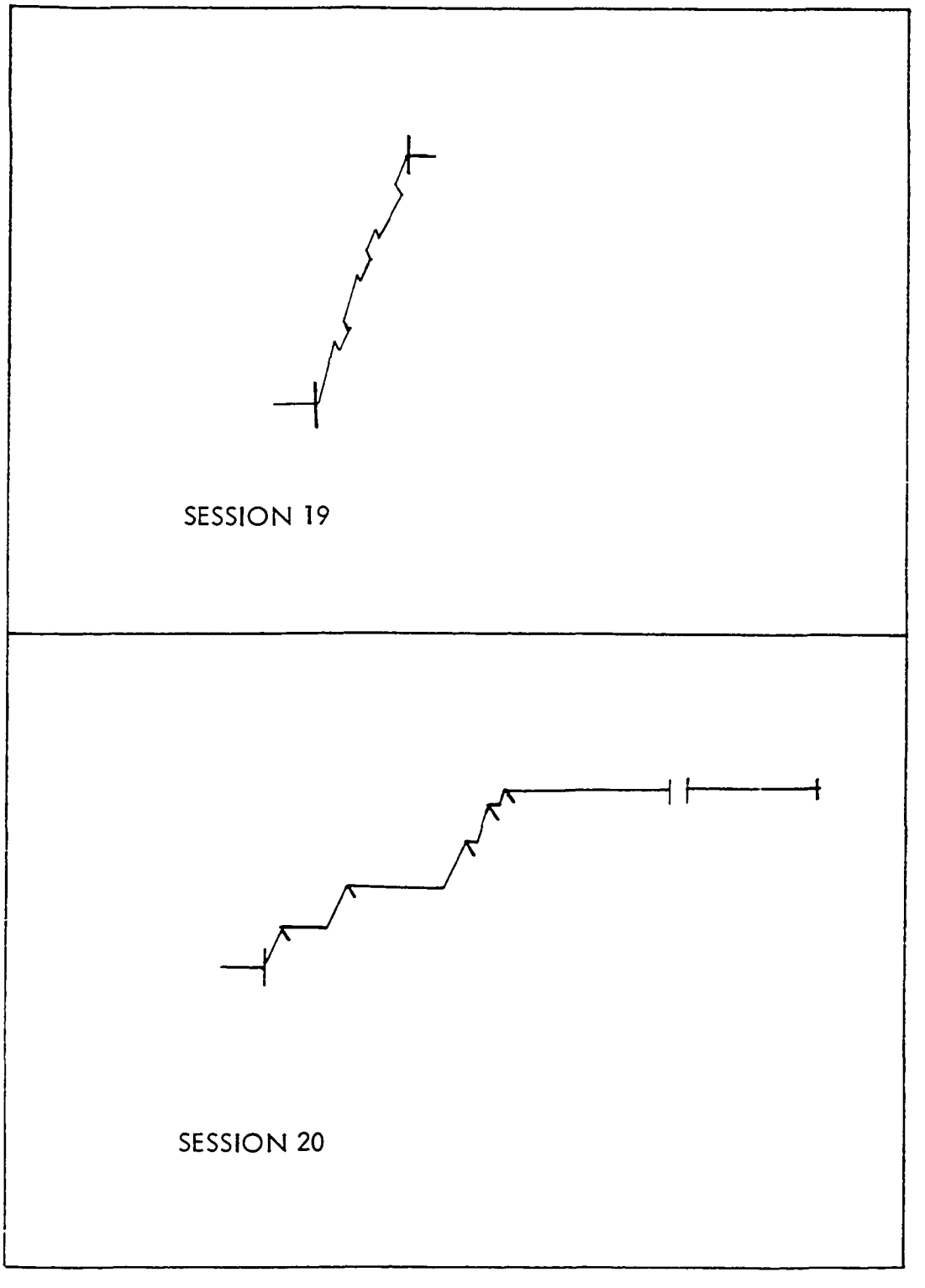


Figure 5. Effectiveness of conditioned punisher on self-injurious behavior

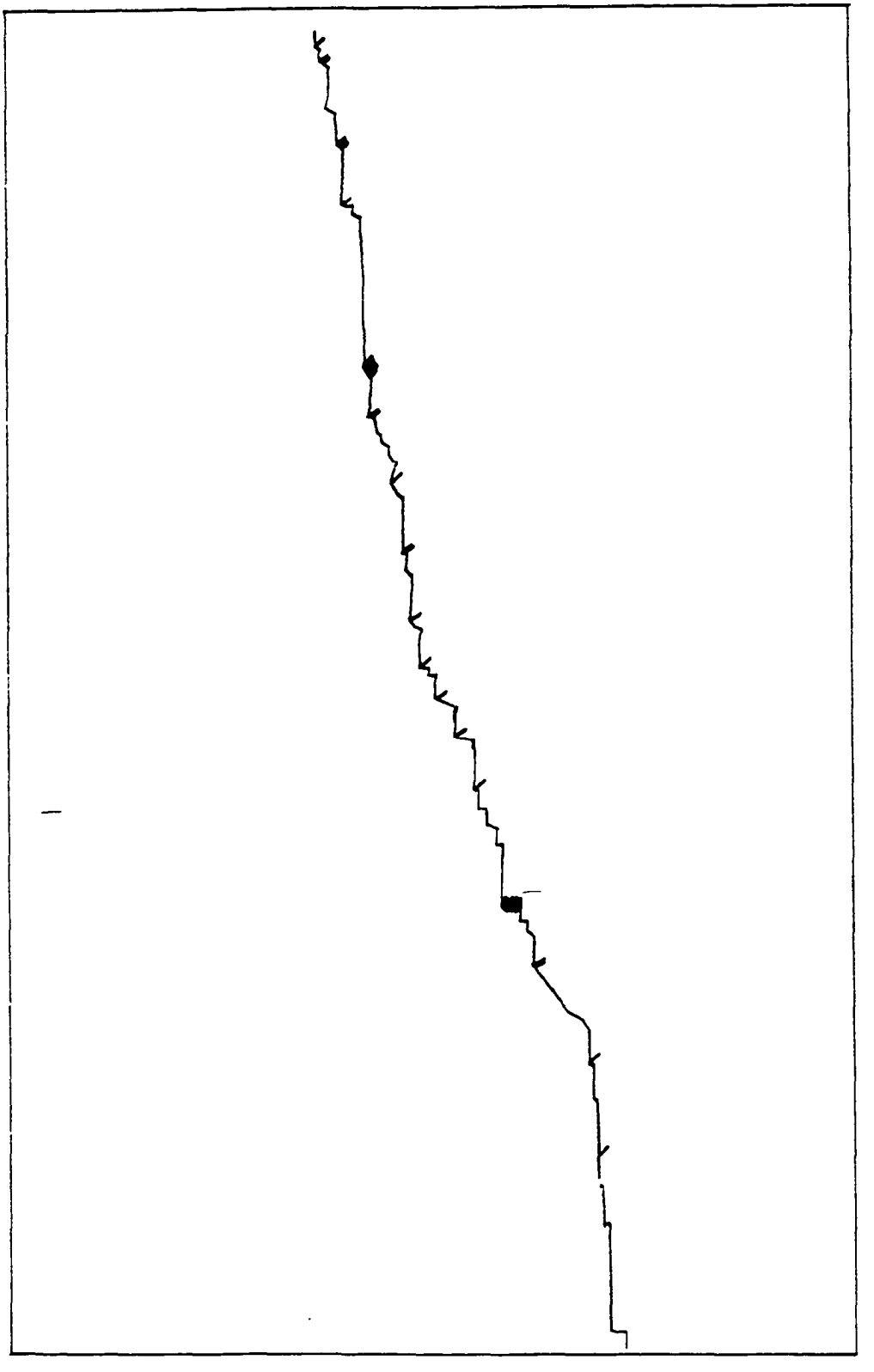
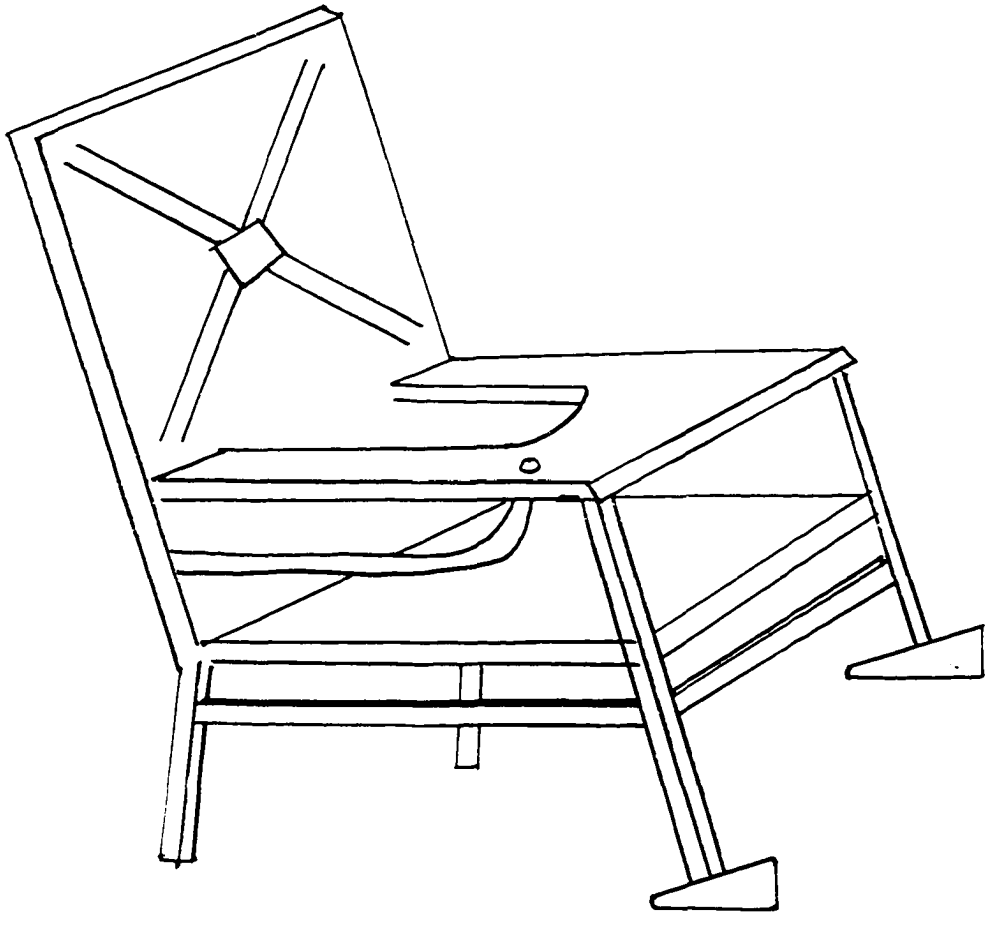


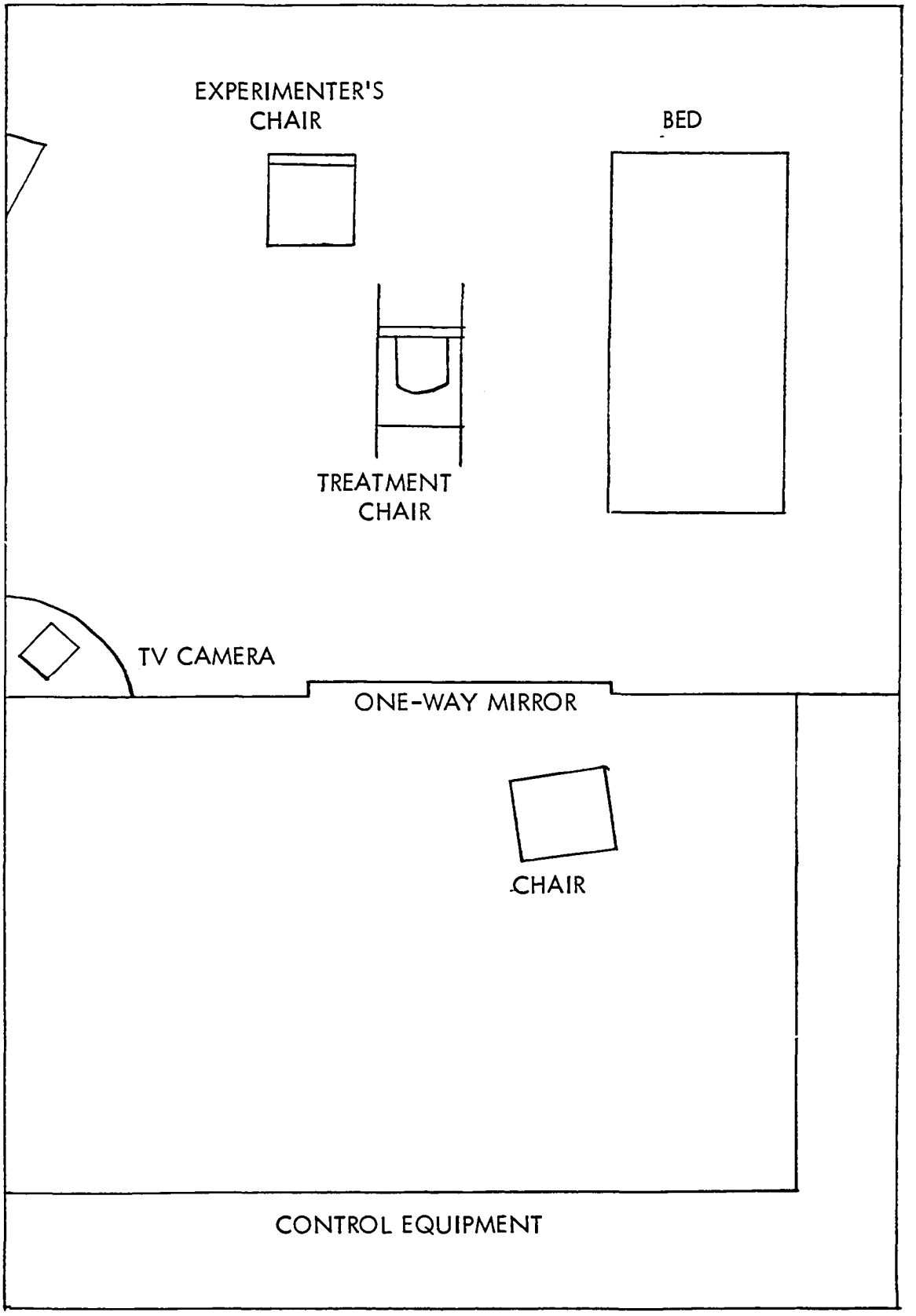
Figure 6. Cumulative record of Session 23

APPENDIX A



TREATMENT CHAIR

APPENDIX B



APPENDIX C

PROCEDURE					
TEST		PAIRING		TEST	
BASELINE	BASELINE WITH BUZZER	NONCONTINGENT PAIRING	CONTINGENT PAIRING	PROBE	EXTINCTION
×					
×					
×					
×					
	×				
		×			
				×	
		×			
				×	
		×			
				×	
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		×		×	
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		×		×	
		×		×	
				×	
				×	
			×		
					×
					×
					×
					×

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