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Extinction-Induced Aggression in Laboratory Rats

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Abstract

In a study by Azrin et al. (1966), it was found that pigeons attacked other pigeons when the transition from a food reinforcement schedule to an extinction schedule was employed. These aggressive behaviors that appear due to the implementation of an extinction schedule, however, has not been widely studied in the laboratory rat. Examples of the types of phenomena that have been given attention with regard to laboratory rat aggression are male aggression in a mixed-sex colony toward male intruders, attack elicited by the application of aversive stimuli, and female-elicited aggression of male rats living in colonies. The expression of aggressive behaviors in rats appears to be highly responsive to developmental, experiential, and contextual variables. The present study focuses upon aggression displayed toward two characteristically different objects--one a stuffed rat and the other a wood block--when an extinction schedule is employed with laboratory rats. By using an extinction paradigm with rats bar-pressing for food, the present study examines aggression in this context by measuring the intensity and type of aggressive behavior displayed toward the two different objects as well as looking at other behaviors elicited by an extinction schedule.

Review of Literature

Aggression in the laboratory rat has been studied extensively in a wide variety of contexts. Particularly, there have been a number of studies that focus on what situations produce or elicit aggressive behaviors in the laboratory rat (see Lore, Nikoletseas, & Takahashi, 1984 for review). One of the most effective procedures developed to study aggression in the laboratory rat is the examination of behavioral responses of established colonies of domesticated rats to the presence of an unfamiliar intruder of the same species (Barnett, 1960; Blanchard et al., 1975). This procedure has been the basis for studying other aspects of aggression in the rat such as aggressive acts elicited by male intruders in mixed-sex colonies (effects of the sex of the rat), aggression due to the application of an aversive stimulus (Ulrich and Azrin, 1962), and aggression as a result of an extinction procedure (Azrin et al., 1966). Other studies have focused upon factors influencing aggression such as the presence of females in a colony (cohabitation) (Barnett, 1958; Barnett et al., 1968; Thor and Flannelly, 1976), competitive experience (Albert et al., 1989), and the manipulation of the rat's food supply (Lore et al., 1986). These studies and their relevance to the present study are discussed in detail below.

As described earlier, it has been found that male aggression is often elicited when a male intruder is introduced to male rats in a mixed-sex colony. This phenomenon has been studied in both wild and domestic Norway rats. Early studies showed a profound discrepancy between the reactions of wild rat colonies and those of laboratory colonies to a conspecific intruder. The wild rats attacked and either injured or killed the intruder, while the albino rats did not (Barnett, 1960). However, later studies of albino rat colonies produced consistent and dramatic attacks on conspecifics (Blanchard et al., 1975). These colonies produced wounding and mortality rates for intruders which were equivalent to those shown by wild rat colonies under similar circumstances (Blanchard et al., 1975). Therefore, from the above literature, one can assume that the use of laboratory rats for studies in aggression can produce results similar to those of studies using wild rats.

Aggression in the form of attacking another rat can also be elicited by the application of an aversive stimulus. Ulrich and Azrin (1962) found that certain aversive stimuli produce attack toward another rat. By placing two male rats in the same arena and comparing their behavior prior to the application of the aversive stimuli to their behavior after it, the examiners found that soon after the delivery of certain aversive stimuli, fighting would occur between rat pairs while fighting did not occur before the application of the aversive stimulus. The aversive stimuli found to elicit fighting were electrode shock and a heated floor, while intense noise and a cooled floor did not elicit this behavior. Also, these results showed that under optimal conditions, shock-elicited fighting occurred regardless of the rat's sex, strain, previous familiarity with each other, or the number present during shock.

The presence of females in a colony or, cohabitation, has also been reported to produce and actually increase the aggression of male colony members. Barnett (1958) and Barnett et al. (1968) found that cohabitation with females increased aggression levels of male rats living in laboratory colonies. Flannelly and Lore (1977) examined the reactions of males to intruders after a one-week period of cohabitation with pairs of either intact females, ovariectomized females, or intact males of comparable size to females. They found that only intact females could elicit increased aggression of resident males toward an intruder. Other studies, however, failed to show that cohabitation enhanced aggression against intruders in mixed-sex colonies of domestic rats (Barnett, 1960; Thor and Flannelly, 1976).

Competitive experience is yet another factor influencing the expression of aggression. Albert et al. (1989) found that competitive experience actually enhances aggression in the laboratory rat. He found that rats with testosterone implants that had been subjected to food competition were more aggressive toward an unfamiliar male than were rats with testosterone implants that had not been given the competitive experience. Also, rats with testosterone implants given competitive experience were more aggressive than their castrated cagemates, but rats with testosterone implants not given competitive experience were not more aggressive than their cagemates. These results confirm other evidence that activation of social aggression in rats need not require increased testicular testosterone secretion. Likewise, these results clearly demonstrate that competition for food enhances aggression toward a male intruder.

Aggression in rats is also affected by food supply. In an experiment by Lore et al. (1986), individually housed rats subjected to short-term food restriction displayed more territorial aggression toward an intruder than controls maintained on a free-feeding diet. The exact motivations for this aggression, however, were not evident. Was the aggression due to the fact the the rat perceived the intruder as a competitor for food or was it because the rat was just generally "frustrated" because the food supply was limited and chose aggression as a manifestation of that "frustration"? Regardless of the motivation, results from this study suggest that when food is abundant, rats "tolerate" each other but when food supply is limited, social intolerance increases and rats become more aggressive.

There are also aversive properties to extinction procedures. Several studies have shown that aggression can be elicited by an extinction procedure. Such aggression is evidenced by oscillations in response rates (Skinner, 1938), attacking of the response lever (Mowrer and Jones, 1943), and increased running speed after omission of a reinforcement for running (Amsel and Roussel, 1952). A study by Azrin et al. (1966) found that pigeons would attack another pigeon if the transition from food reinforcement to extinction was employed while the other pigeon was present. Azrin et al.

(1966) used pigeons that were put through a series of conditions of food reinforcement following an ABA design (a baseline followed by a manipulation followed by another baseline) consisting of no reinforcement, reinforcement-extinction, and no reinforcement again. During the first no reinforcement condition, a target pigeon was placed in a restraining device and the experimental pigeons' aggressive acts were measured (baseline). During the reinforcement-extinction condition, subjects alternated between periods of continuous reinforcement and periods of extinction with the target pigeon placed in the same chamber. The second no reinforcement condition followed. Results from Azrin's study showed that attack duration was increased by the reinforcement-extinction procedure and was maintained for as long as it remained in effect. The reversibility of the phenomenon was also demonstrated by the change in attack duration when the reinforcement-extinction procedure was discontinued, reinstated, and discontinued again.

As seen in the above review, there are many factors which elicit aggression in several situations. Based on the existing literature, it is unclear what the precise factors are that elicit aggression in specific situations. Aggression in rats is by no means a unitary trait displayed in all contexts. Further, the expression of aggressive behaviors in rats appears to be highly responsive to developmental, experiential, and contextual variables. This study uses a variation of the extinction paradigm of Azrin et al. (1966)--a fixed-ratio 15 schedule of reinforcement is used and observation of baseline aggression is done during responding on this schedule. An extinction schedule follows and does not use reinforcement and then extinction as was used in Azrin et al.'s study. Also, this study differs in that we implemented rats as subjects. While looking at the differences in the type and frequency of aggression, the present study attempts to further generalize Azrin et al.'s study.

One area of laboratory rat aggression that has received little attention is the effect of the target stimuli upon the expression of aggression in rats. Some studies have used live targets (another rat) for studies in aggression (Ulrich and Azrin, 1962; Albert et al., 1989) while other studies have used stuffed versions of the species they are studying (Azrin et al., 1966). Numerous other studies have used yet another target for aggression--inanimate objects--in examining aggressive behaviors (Timberlake and Grant, 1975). There are not any known studies to date that have examined a comparison between stimuli used as targets for aggression in the laboratory rat. Further, specific effects of the targets mentioned above have not been studied extensively.

Two theories exist that address what effects target stimuli should have on subjects' aggression when they are exposed to two characteristically different objects. The first of these theories is the behavior systems theory. Behavior systems theory claims that the stimuli used should make a difference in the types of behaviors an organism directs toward that stimulus. In a study by Timberlake and Grant (1975), it was shown that the stimulus used to predict a reinforcer had an effect on the type of response the organism performed. In this study, rats that were given another rat to predict the delivery of food directed social rather than eating behavior toward this other rat. Further, they showed that rats could be conditioned to approach and contact a live rat, although not a block of wood that predicted the delivery of food. Therefore, they offered the alternative hypothesis that the form of behavior in the presence of the predictive stimulus will depend on which behaviors in the conditioned system are elicited and supported by the predictive stimulus. In other words, behaviors directed toward a stimulus will be appropriate for that stimulus. A rat should behave differently toward a social stimulus (a rat) than toward a non-social stimulus (a wood block).

The second theory that addresses the effects of target stimuli is the frustration-aggression hypothesis. This hypothesis states that if an organism is "frustrated" such as by delivering an aversive stimulus or implementing an extinction procedure, the organism will aggress (Bolles, 1975). The frustration is seen as an emotional state the organism is in while the aggression is the expression of that emotional state (Dollard et all, 1939). Frustration-aggression theory would predict that the stimulus used as a target for aggression does not matter. The organism will not be selective in what object it chooses to aggress toward more.

The present study pits these two theories against each other. By using two characteristically different objects as targets for aggression--a stuffed rat and a wood block--this study will examine the effects of target stimuli on the expression of aggressive behavior using a similar version of Azrin et al.'s paradigm of extinction, but with rats. Behavior systems theory predicts the rat will not treat the stimuli the same while the frustration-aggression theory predicts that the rats will not prefer one target object over another.

General Experimental Design

Subjects

Five male Long-Evans rats, previously used in a Psychology 211 course, served as experimental subjects. All subjects were housed separately in wire cages with lighting on a 12/12 hour light/dark cycle. Subjects had unlimited access to water and were fed one hour after each experimental session.

Apparatus

The apparatus used was a standard operant conditioning unit for rats. The apparatus was 27 cm in width, 27 cm in length, and 30 cm in height. Two response bars were located on the front wall, 8 cm from the wire-grid floor and 4 cm from either the left or right wall. The bars were 5 cm wide and a white light was positioned 7 cm above either bar. Only the right bar was operable during the experiment and only the light above the right bar was on at any time during the experiment. Food was delivered in a small, square, recessed food cup 1 cm from the grid floor and 11 cm from either the left or right wall. The area for the rat to access the food was 3.5 cm in height and 4.5 cm in width. One houselight was mounted in the upper left front corner of the apparatus. The entire apparatus was housed in a sound-attenuating chamber. An exhaust fan masked outside noise.

The wood block used as a target stimulus was 10 cm in length, 4 cm in width, an 3 cm in height. The block was painted yellow.

The stuffed rat, also used as a target stimulus, was 26 cm from nose to tail, 11.5 cm in length for the body, 5 cm in width, and 5 cm in height. The rat was made by the experimenter from a cat toy and was colored to resemble a Long-Evans rat. Characteristics of the stuffed rat were black eyes made of felt, red ears colored black, a black stripe down the middle of its back, and a black face, neck, and genital region.

Procedure

All five subjects were food deprived to 80% of their free-feeding weight before the experiment began. While on food deprivation, the subjects were trained to bar-press for food. A fixed-ratio 15 schedule of reinforcement (the rat must press the bar 15 times to receive one reinforcer) was implemented for 15 sessions to observe baseline responding. Each session lasted approximately 20 minutes. In each of the last 3 sessions of the 15 sessions of baseline, three rats (subjects 1,2,3) were exposed to the stuffed rat during responding while the other two rats (subjects 4,5) were exposed to the wood block. This was done in order to observe baseline levels of aggression toward these objects.

In the 16th session, the rats underwent a food extinction schedule (rats press the bar and receive no reinforcers) with either the target rat or the wood block present in the same cage. Next, a second baseline consisting of 3 sessions (responding had once again stabilized after just three days on the fixed-ratio 15 schedule) was implemented and the above procedure was repeated. However, the three rats that first received the stuffed rat got the wood block and the two rats that first received the wood block got the stuffed rat. This was done to eliminate any bias due to order of presentation.

Observation of aggressive behaviors was done by the experimenter. The experimenter wrote down behaviors in the order they appeared in baseline and extinction. A tally was then kept as the rats repeated each behavior. The experimenter sat approximately 2-3 feet from the apparatus in which the rats performed. The lights in the room were out at all times and the only light was from the houselight of the apparatus. The entire apparatus was in view at all times.

Composite aggression scores, consisting of the number of attacks (pushing or rolling the object over), plus the number of bites (directed toward the tail, neck, back, face, or genital area of the rat), plus the number of other aggressive behaviors not classified but directed toward the object, were computed and compared to baseline levels of aggression. Other "frustrating" behaviors that were not directed toward the object were also recorded.

Statistics

A t-test for a within-subjects paired sample was performed on the data.

Results

Aggression scores were calculated by adding together the number of aggressive acts across all subjects toward each object during both baseline and extinction and averaging them. For example, for all subjects, the total number of aggressive acts toward the rat during baseline was 63. Divide that by three days of baseline for each of five subjects (15) and one arrives at 4.2.

Figure 1 depicts the relationship between the average number of aggressive acts per session toward either the stuffed rat or the wood block and the number of aggressive acts subjects displayed during baseline and extinction. Aggressive behaviors toward the objects included biting, pushing, picking up and rolling the object over, urinating on the object, and dragging the object by the tail (rat only). The closed dots represent aggressive acts toward the stuffed rat while the open dots represent aggressive acts toward the wood block. The aggression score is an average number of aggressive acts toward the object per session.

As Figure 1 shows, there was a significant increase in aggressive behaviors directed toward both the stuffed rat ($t(4) = 4.50$, $p<.05$) and the wood block ($t(4) = 3.44$, $p<.05$) when the schedule of reinforcement was changed from a fixed-ratio 15 (baseline) to an extinction schedule. The average number of aggressive behaviors toward the stuffed rat during baseline was 4.2 per session while the average number toward the wood block was 5.2. This was not a significant difference. Likewise, during extinction, we found no significant difference between the average number of aggressive acts displayed toward the stuffed rat (26) and the number toward the wood block (26.3).

There were five aggressive behaviors recorded that were directed toward the targets. These were biting, pushing, picking up and rolling over the object, urinating on the object, and dragging the object by the tail (rat only). Figure 2 displays the mean occurrence for each aggressive behavior during baseline and extinction. This includes all subjects and combines both targets. Standard error bars are included.

Breaking down the data even further, Table 1 shows the number of times each subject displayed each of these aggressive behaviors during baseline and during extinction toward either the wood block or the stuffed rat. One-tailed t-test scores are listed below and an asterisk denotes significance at the .01 level while the number sign denotes significance at the .05 level. As one can see, the only aggressive behavior that had a significant increase from baseline to extinction was biting. This occurred for both the wood block and the stuffed rat. All other behaviors did not have a significant increase across all subjects and both targets.

Responses on the bar per minute for each subject were calculated and are shown in Figure 2. Sessions 1-12 constitute the regular baseline (responses per minute on an FR-15 schedule of reinforcement). Sessions 13-15 show responses per minute during baseline aggression-Phase 1 where the target object is present in the cage but the subjects are still receiving reinforcers. Note that subjects 1,2, and 3 are being exposed to the stuffed rat while subjects 4 and 5 are being exposed to the wood block here. Sessions 16 and 17 are extinction procedure sessions of Phase 1. It is evident in all subjects that there was a significant decrease in response rates during this procedure of extinction. Sessions 18-20 revert back to the FR-15 schedule and , as you can see, responding either equalled or surpassed the original level of responding seen in sessions 1-12 in just three sessions. Sessions 21-23 show Phase 2 baseline aggression response rates where now subjects 1,2,and 3 are being exposed to the wood block and subjects 4 and 5 are being exposed to the stuffed rat. Finally, Sessions 24 and 25 display the extinction procedure of Phase 2. Responding once again drops considerably. Gaps in the graphs indicate a loss of data for that session.

Discussion

These results have provided evidence that extinction schedules produce an increase in aggressive behaviors. Also, there appears to be no difference in the number of aggressive acts displayed toward either the stuffed rat or the wood block. This study has further generalized Azrin's results with pigeons by showing that the same phenomenon, extinction-induced aggression, occurs in the laboratory rat as well.

Another interesting finding was that the only significant increase between baseline and extinction (all subjects included) was in the biting behavior displayed toward either the wood block or the stuffed rat. Other aggressive behaviors fluctuated by subject but overall, subjects as a group showed no significant difference between baseline and extinction in the behaviors of pushing the object, picking up and rolling the object over, urinating on the object, or dragging the object by the tail (rat only).

Implications for the two theories put forth earlier would seem to be that the results are consistent with the frustration-aggression hypothesis and not with the behavior systems hypothesis. However, based on the data from this study, one cannot draw this conclusion about which theory is supported or not supported. For one, the rat may not have viewed the stuffed rat as being a social stimulus (another rat like itself). The stuffed rat may not have had the characteristics that normally elicit the aggressive behaviors seen toward a live rat (smell of the rat, or physical characteristics of the rat such as its eyes, ears, tail, markings, etc.).

Future research should take many things into consideration when examining behavior in the laboratory rat. One should look at the advantages of using a live rat as a target versus a stuffed rat. One advantage of using the live rat is that there is no ambiguity as to whether the rat views the target as real or not. If a stuffed rat is used, however, one's focus should be on making the stuffed rat seem as real as possible (putting urine on the stuffed rat or stuffing a dead rat). Furthermore, one should have in mind specific aggressive behaviors to look for before the experiment begins. By examining these aggressive behaviors more closely, future research may want to focus on why only biting was significantly higher in extinction. Other research may want to focus on laboratory rats' preferred aggressive behaviors to see which ones may be innate and which may be socialized behaviors.

Finally, some interesting results could come from looking specifically at what cues the rat looks for when deciding to aggress toward an object. By manipulating the appearance of the wood block or any other inanimate object by placing ears on it or by coloring it to look like a rat and adding a tail, studies could examine the exact characteristics preferred to produce the most intense attack.

References

Albert, D. J., Petrovic, D. M., & Walsh, M.L. (1989). Competitive experience activates testosterone-dependent social aggression toward unfamiliar males. Physiology and Behavior, 45, 723-727.

Amsel, A., & Roussel, J. (1952). Motivational properties of frustration: I: effect on a running response of the addition of frustration to the motivational complex. Journal of Experimental Psychology, 43, 363-368.

Azrin, N. H., Hutchinson, R. R., & Sallery, R. D. (1964). Pain-aggression toward inanimate objects. Journal of the Experimental Analysis of Behavior, 7, 223-227.

Azrin, N. H., Hutchinson, R. R., & Hake, D. F. (1966). Extinction-induced aggression. Journal of the Experimental Analysis of Behavior, 9(3), 191-204.

Barnett, S. A. (1958). An analysis of social behavior in wild rats. Proceedings of the Zoological Society of London, 130, 107-152.

Barnett, S. A. (1960). Social behavior among tame rats and among wild-white hybrids. Proceedings of the Zoological Society of London, 134, 611-621.

Barnett, S. A., Evans, C. S., & Stoddart, R. C. (1968). Influence of females on conflict among wild rats. Journal of Zoology, 154, 391-396.

Blanchard, R. J., Fukunaga, K., Blanchard, D. C., & Kelly, M. J. (1975). Conspecific aggression in the laboratory rat. Journal of Comparative and Physiological Psychology, 89, 1204-1209.

Blanchard, R. J., & Blanchard, D. C. (1977). Aggressive behavior in the rat. Behavioral Biology, 21, 197-224.

Blanchard, R. J., Blanchard, D. C., Takahashi, T., & Kelley, M. J. (1977a). Attack and defensive behavior in the albino rat. Animal Behavior, 25, 622-624.

Blanchard, R. J., Takahashi, L. K., & Blanchard, D. C. (1977b). The development of intruder attack in colonies of laboratory rats. Animal Learning and Behavior, 5(4), 365-369.

Blanchard, R. J., & Takahashi, L. K. (1978). Pain and aggression in the rat. Behavioral Biology, 23, 291-305.

Blanchard, D. C., Fukunaga-Stinson, C., Takahashi, L. K., Flannelly, K. J., & Blanchard, R. J. (1984). Dominance and aggression in social groups of male and female rats. Behavioural Processes, 9, 31-48.

Bolles, R. C. (1975). Theory of motivation. 2nd ed. New York: Harper and Row, 400-410.

Dollard, J., Doob, L. W., Miller, N. E., Mowrer, O. H., & Sears, R. R. (1939). Frustration and aggression. New Haven, Conn.: Yale University Press.

Flannelly, K. J., & Lore, R. K. (1977). The influence of females upon aggression in domesticated male rats (*Rattus Norvegicus*). Animal Behavior, 25, 654-659.

Lore, R. K., Nikoletseas, M., & Takahashi, L. (1984). Colony aggression in laboratory rats: A review and some recommendations. Aggressive Behavior, 10, 59-71.

Lore, R. K., & Stipo-Flaherty, A. (1984). Postweaning social experience and adult aggression in rats. Physiology and Behavior, 33, 571-574.

Lore, R. K., Gottdiener, C., & Delahunty, M. J. (1986). Lean and mean rats: Some effects of acute changes in the food supply upon territorial aggression. Aggressive Behavior, 12, 409-415.

Mowrer, O. H., & Jones, H. (1943). Extinction and behavior variability as a function of effortfulness of task. Journal of Experimental Psychology, 33, 369-386.

Skinner, B. F. (1938). The Behavior of Organisms: An Experimental Analysis. New York: Appleton-Century-Crofts.

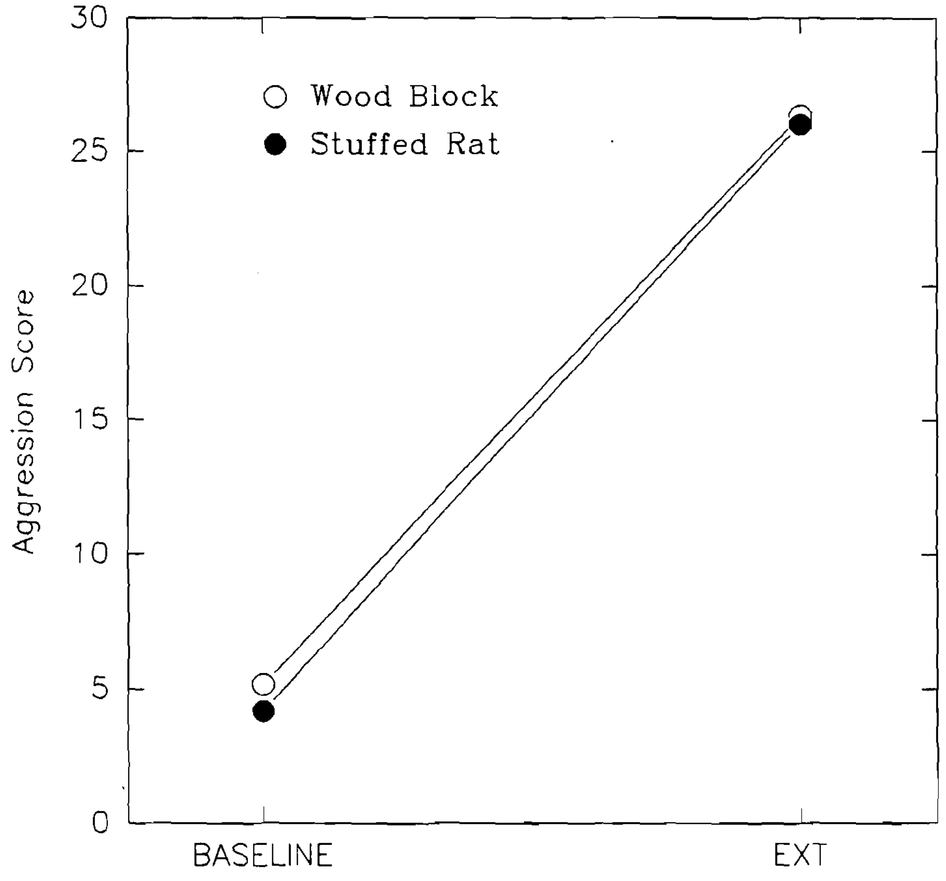
Takahashi, L. K., & Blanchard, R. J. (1982). Attack and defense in laboratory and wild Norway and black rats. Behavioural Processes, 7, 49-62.

Thor, D. H., & Flannelly, K. J. (1976). Age of intruder and territorial-elicted aggression in male long-evans rats. Behavioral Biology, 17, 237-241.

Timberlake, W., & Grant, D. L. (1975). Auto-shaping in rats to the presentation of another rat predicting food. Science, 19, 690-692.

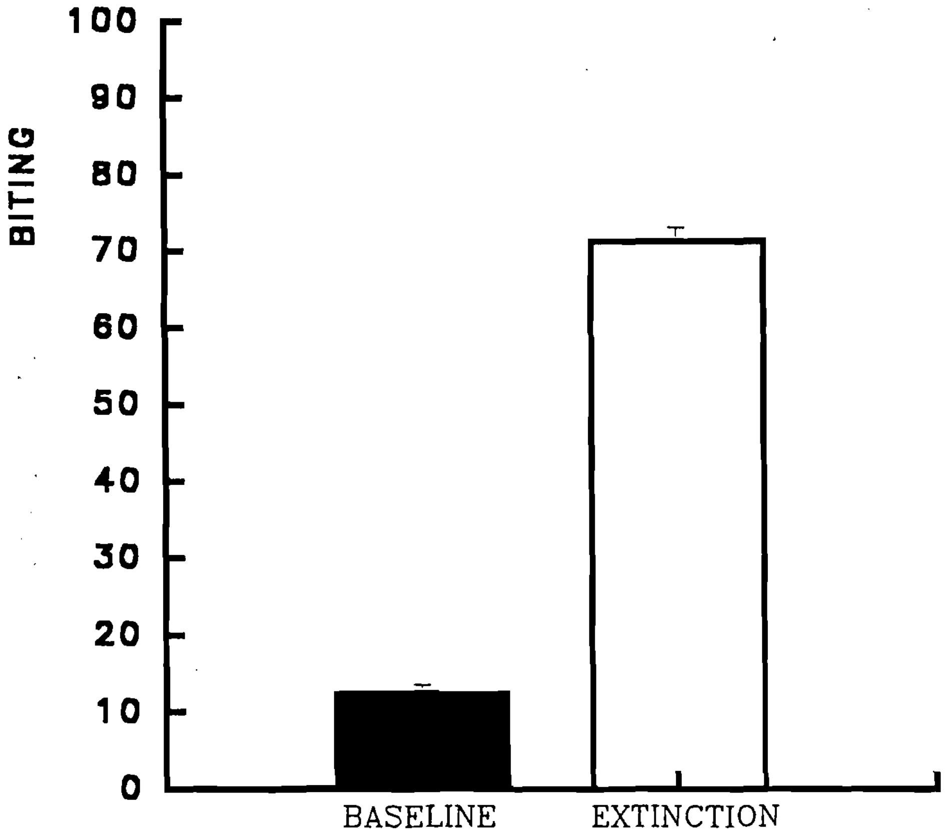
Ulrich, R. E., & Azrin, N. H. (1962). Reflexive fighting in response to aversive stimulation. Journal of the Experimental Analysis of Behavior, 5(4), 511-520.

Figure 1- Average number of aggressive acts per session toward the wood block or the stuffed rat during baseline and extinction.

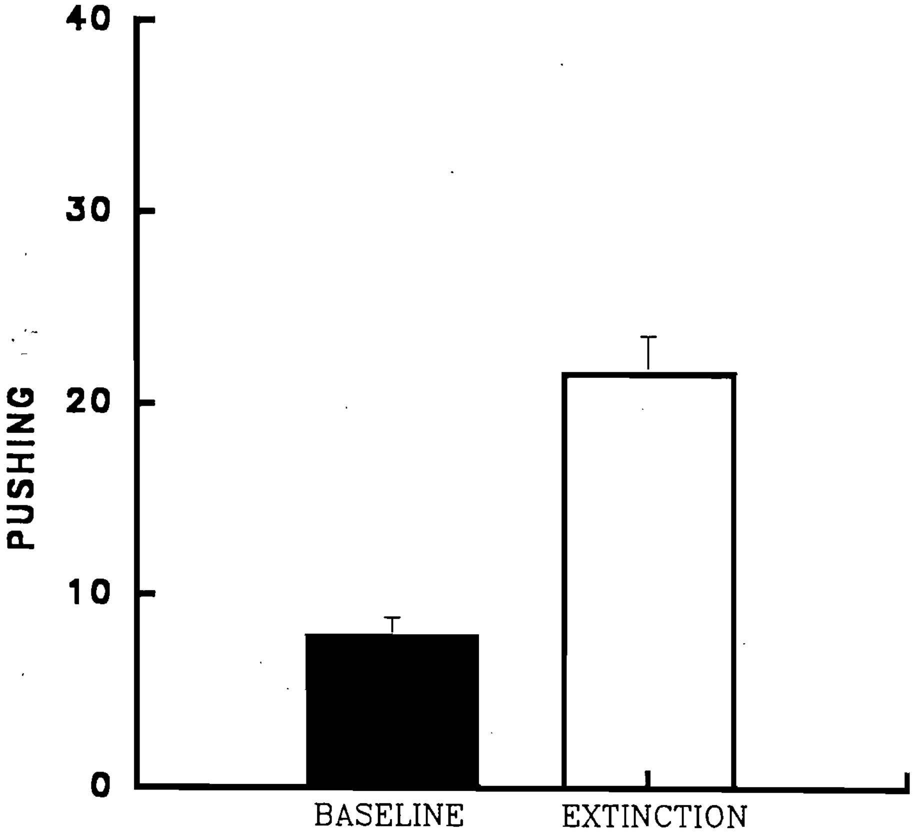


Wood Block
Stuffed Rat
Aggression Score
30
25
20
15
10
5
0
BASELINE
EXT

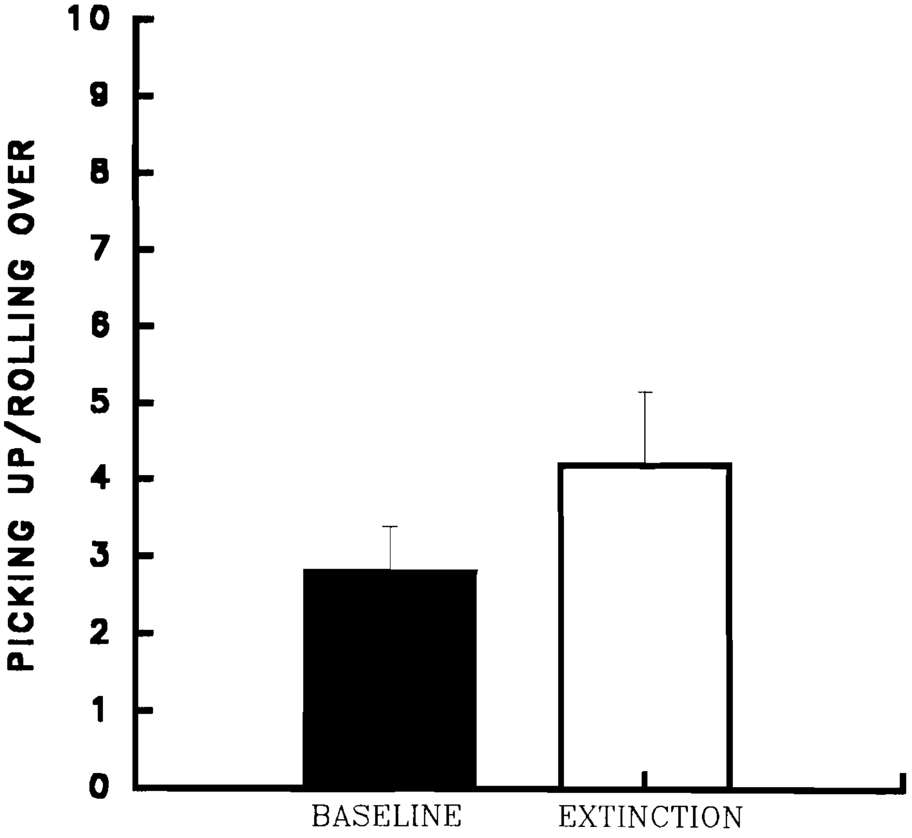
Figure 2- Mean occurrence of aggressive behaviors toward target objects during baseline and extinction across all subjects. Standard error bars are included.

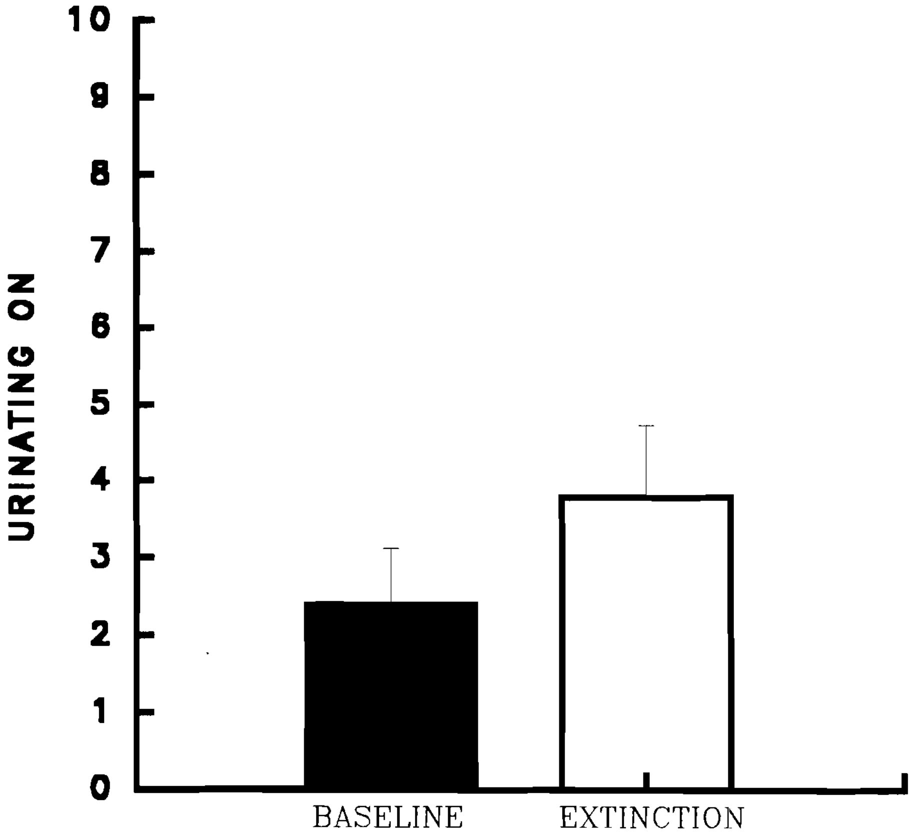


100
90
80
70
60
50
40
30
20
10
0
BITING
BASELINE
EXTINCTION



40
30
20
10
0
PUSHING
BASELINE
EXTINCTION


PICKING UP/ROLLING OVER
10
9
8
7
6
5
4
3
2
1
0
BASELINE
EXTINCTION


URINATING ON
10
9
8
7
6
5
4
3
2
1
0
BASELINE
EXTINCTION

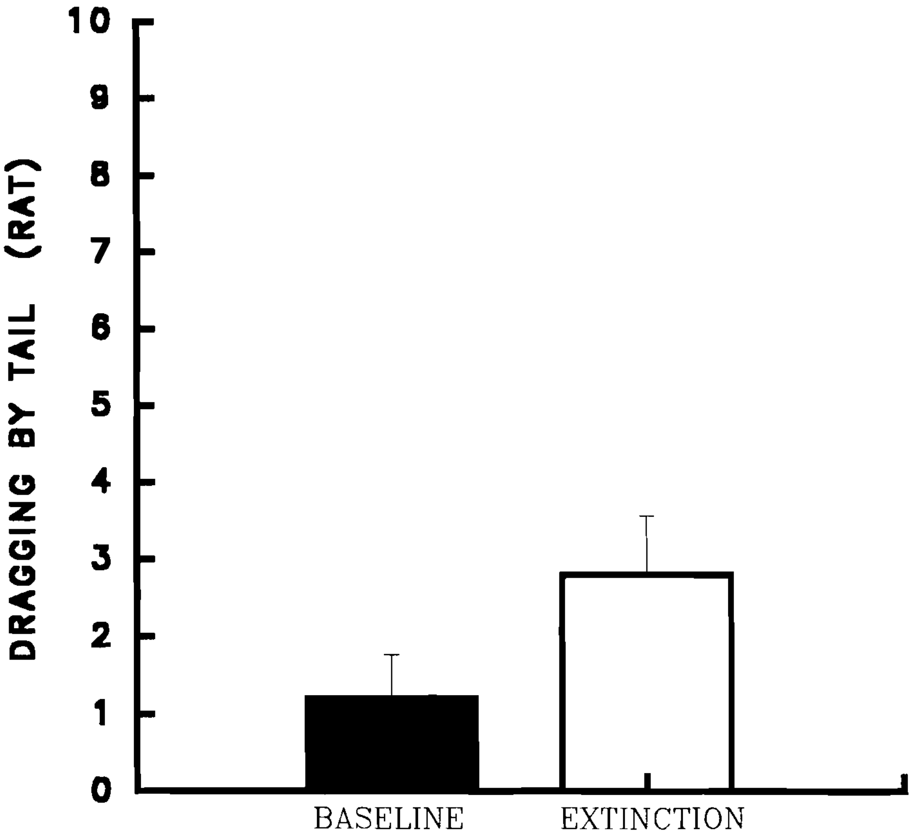

DRAGGING BY TAIL (RAT)
10
9
8
7
6
5
4
3
2
1
0
BASELINE
EXTINCTION

Table 1- Comparison of the number of times each subject displayed each type of aggressive behavior toward either the wood block or the stuffed rat during baseline and extinction.

Table 1

Biting

		Wood Block		Stuffed Rat	
		Baseline	Extinction	Baseline	Extinction
Subject	1	9	37	6	18
Number	2	4	23	9	34
	3	10	57	5	12
	4	0	19	6	77
	5	0	7	17	72
t-scores		3.74*		2.72#	

Pushing

		Wood Block		Stuffed Rat	
		Baseline	Extinction	Baseline	Extinction
Subject	1	11	43	1	14
Number	2	4	7	0	4
	3	15	12	0	5
	4	1	11	0	1
	5	2	10	6	1
t-scores		1.26		1.23	

Table 1

Picking up/rolling over

		Wood Block		Stuffed Rat	
		Baseline	Extinction	Baseline	Extinction
Subject	1	3	12	0	0
Number	2	5	3	0	2
	3	3	0	0	2
	4	0	2	0	0
	5	0	0	3	0
t-scores		.56		.218	

Urinating on

		Wood Block		Stuffed Rat	
		Baseline	Extinction	Baseline	Extinction
Subject	1	2	8	2	2
Number	2	0	1	0	0
	3	1	4	1	3
	4	0	0	0	0
	5	6	1	0	0
t-scores		.55		1.00	

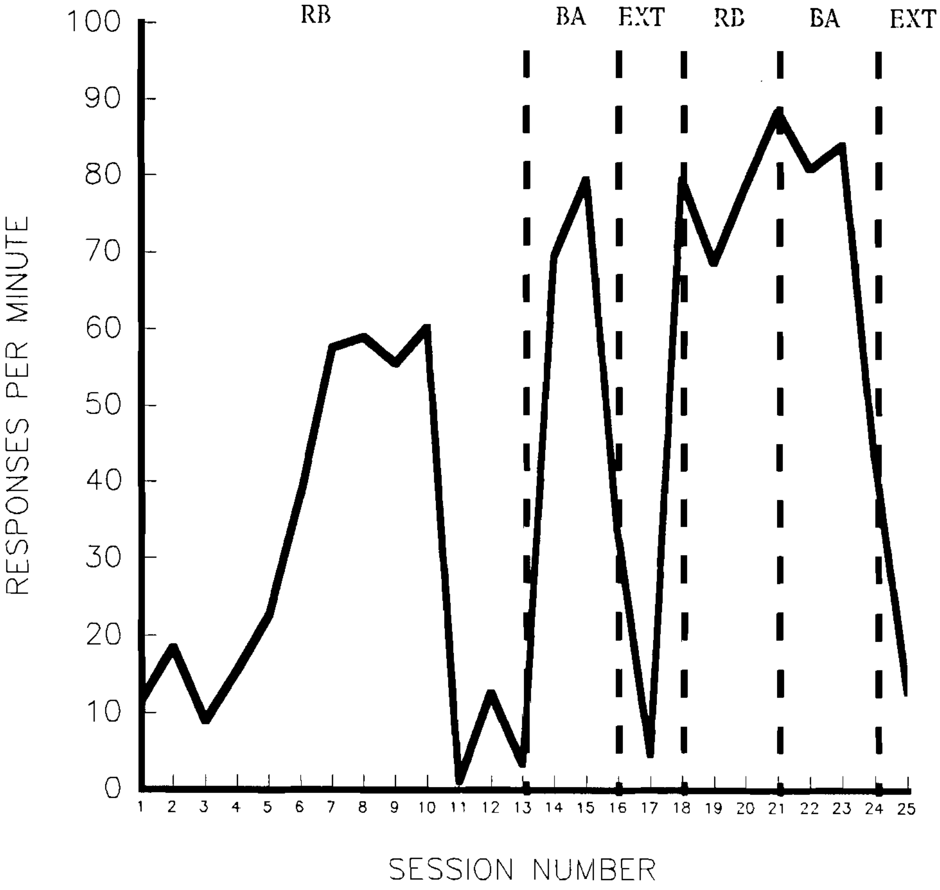
Table 1

Dragging by tail (rat only)

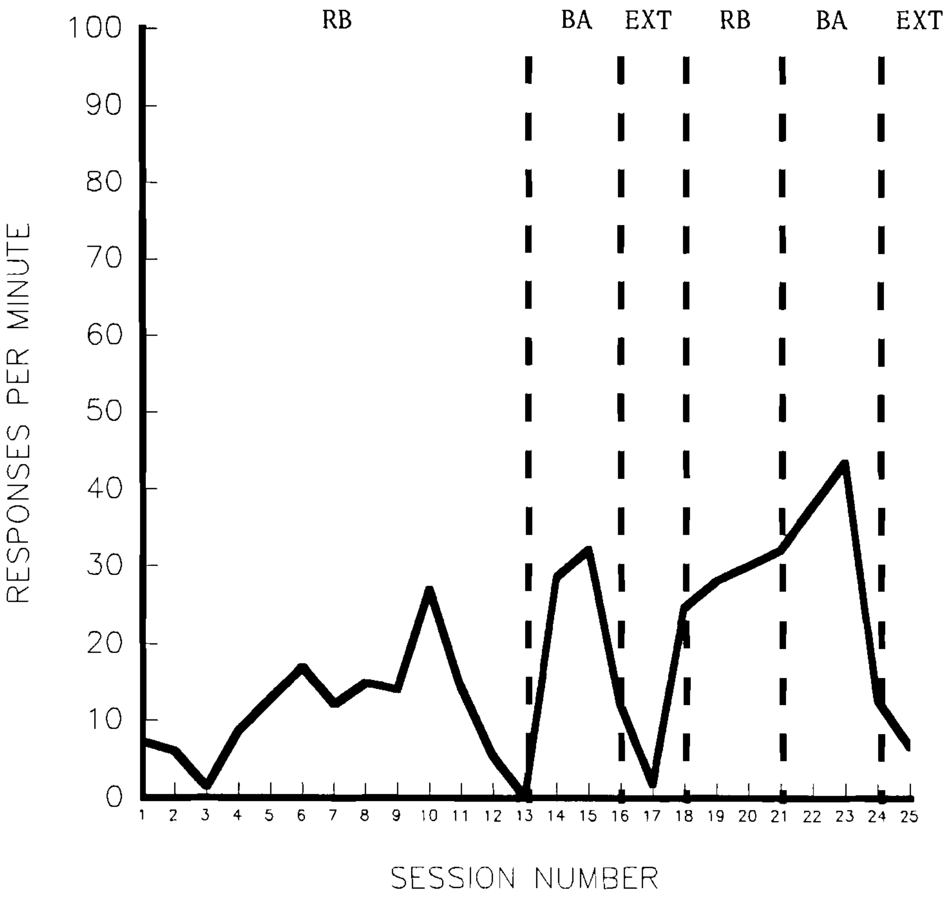
		Stuffed Rat	
		Baseline	Extinction
Subject	1	0	7
Number	2	1	3
	3	0	0
	4	1	0
	5	4	4
t-scores		1.11	

Figure 3- Responses on the bar per minute during all schedules of reinforcement. RB = Regular baseline; BA = Baseline aggression; EXT = Extinction procedure

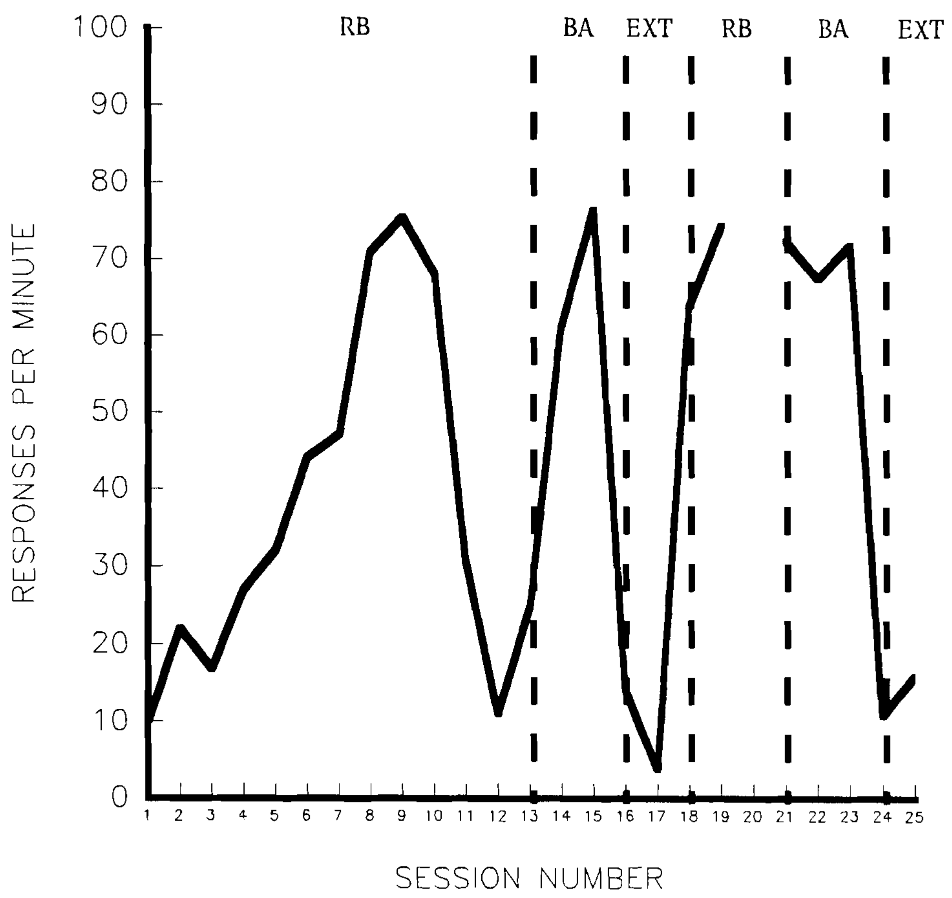
SUBJECT 1


RB
BA
EXT
RB
BA
EXT
100
90
80
70
60
50
40
30
20
10
0
RESPONSES PER MINUTE
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
SESSION NUMBER

SUBJECT 2

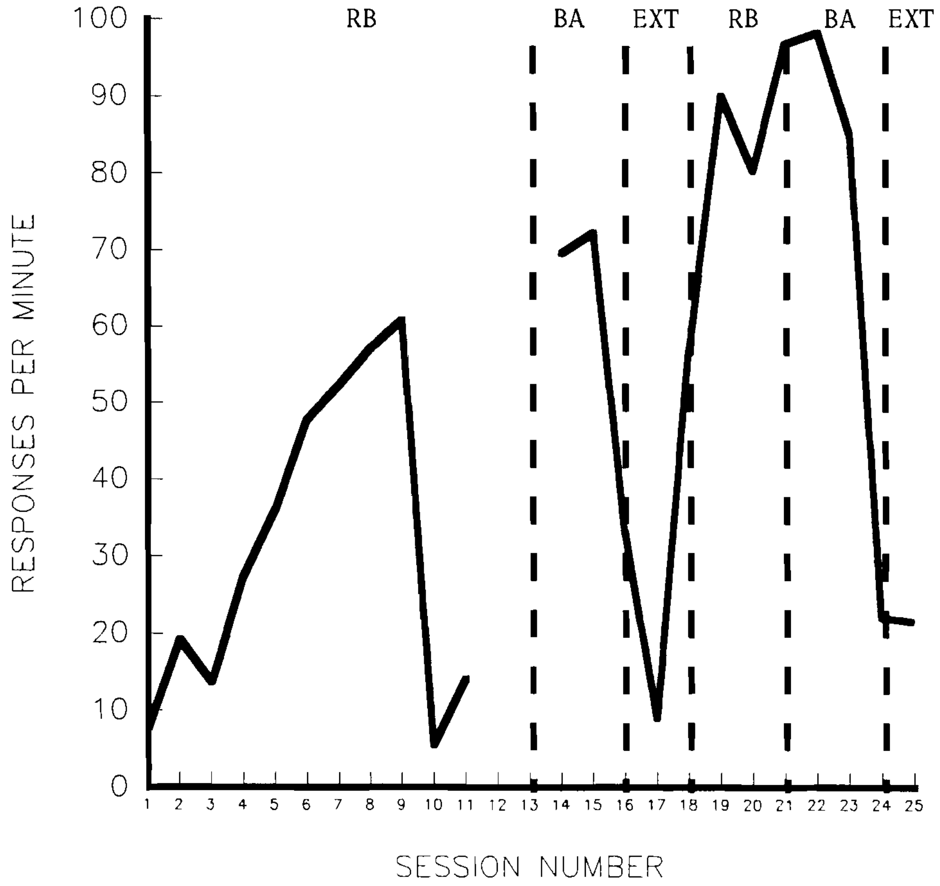

RB
BA
EXT
RB
BA
EXT
100
90
80
70
60
50
40
30
20
10
0
RESPONSES PER MINUTE
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
SESSION NUMBER

SUBJECT 3



RB
BA
EXT
RB
BA
EXT
100
90
80
70
60
50
40
30
20
10
0
RESPONSES PER MINUTE
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
SESSION NUMBER

SUBJECT 4



RB
BA
EXT
RB
BA
EXT
RESPONSES PER MINUTE
100
90
80
70
60
50
40
30
20
10
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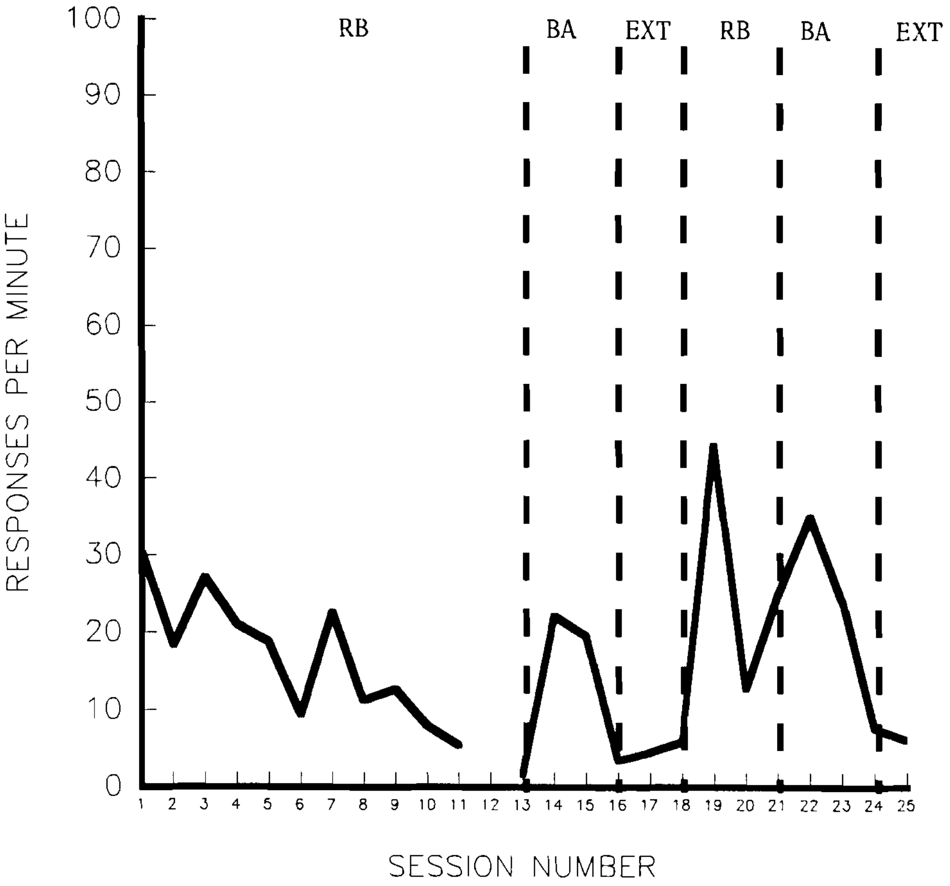
SESSION NUMBER

SUBJECT 5



RB
BA
EXT
RB
BA
EXT
RESPONSES PER MINUTE
100
90
80
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
SESSION NUMBER