SELF-PUNITIVE BEHAVIOR IN THE RAT AS A FUNCTION OF STARTING AREA EXPOSURE, STARTING PROCEDURE, AND EXTINCTION CRITERION

by

Newell Kent Eaton

A THESIS

Presented to the Department of Medical Psychology
and the Graduate Division of the
University of Oregon Health Sciences Center
in partial fulfillment of
the requirements for the degree of

Doctor of Philosophy
July, 1975

APPROVE[redacted]

........[redacted]............

(Professor in Charge of Thesis)

........[redacted]...............

(Chairman, Graduate Council)

TABLE OF CONTENTS

	page
ACKNOWLEDGMENTS	i
LIST OF TABLES	ii
LIST OF FIGURES	iv
INTRODUCTION	1
I. Factors affecting self-punitive behavior	2
II. Contemporary theories of self-punitive locomotor behavior	7
III. Introduction to the specific problem area	11
EXPERIMENT I	21
I. Introduction	21
II. Method	26
III. Results	33
IV. Discussion	63
Experiment II	72
I. Introduction	72
II. Method	74
III. Results	78
IV. Discussion	108
Experiment III	112
I. Introduction	112
II. Method	113
III. Results	115
IV. Discussion	133
SUMMARY, GENERAL DISCUSSION, AND CLOSING COMMENTS	140
REFERENCES	147
APPENDICES	153
Appendix A	154
Appendix B	224

ACKNOWLEDGMENTS

This research was supported by Grant 5 ROI MH 23607-03 from the National Institutes of Mental Health.

I am happy to acknowlege my appreciation to Dr. Judson S. Brown for his unceasing efforts to clarify my thinking, improve my writing, and correct my grammar. I will not soon forget his tenacity in problem solving, unselfishness with his time, and loyalty to his students.

I would also like to thank Johanna Nordlie and Chris Cunningham. Johanna's help in drawing graphs, proof-reading, and typing, along with Chris' insightful comments and sarcastic retorts to my more foolish suggestions, have made this a better dissertation.

I would also like to acknowledge the statistical guidance given me by Drs. Dee Norton, David Phillips, and Leonard Swanson. Drs. Norton and Swanson were instrumental in teaching me whatever I have learned about probability and statistics, while Dr. Phillips helped me solve several practical problems in the analysis of my data.

Thanks also should be extended to the members of my dissertation committee, Drs. Denny, Fitzgerald, Meikle, and Terdal, for their helpful comments on, and patience in reading, my Ph.D. prospectus and final dissertation draft. I wish also to acknowlege Drs. Blachly and Hallum for serving on my final committee.

Finally, I wish to thank my wife, Cheryl, for her patience, encouragement, and assistance throughout my seemingly endless "career" as a graduate student, and to Sam Tsu's English Muffin, who kept her company on the many evenings and weekends that I spent at my desk, in the lab, or at the computer center.

LIST OF TABLES

TABLE		PAGE
1	Summary of the analysis of variance applied to starting scores. The data were compiled according to the goalbox extinction criterion.	41
2	Summary of the analysis of variance applied to first segment (prepunishment) running speeds. The data were compiled according to the goalbox extinction criterion.	48
3	Summary of the analysis of variance applied to third segment (postpunishment) running speeds. The data were compiled according to the goalbox extinction criterion.	53
4	A summary of the analysis of variance applied to starting scores. The data were compiled according to the prepunishment extinction criterion.	57
5	A summary of the analysis of variance applied to the first segment (prepunishment) running speeds. The data were compiled according to the goalbox extinction criterion.	60
6	Mean trials to extinction as a function of extinction treatment and extinction criterion.	62
7	A summary of the analysis of variance applied to starting scores. The data were compiled according to the goalbox extinction criterion.	88
8	An analysis of variance applied to first segment (prepunishment) running speeds. The data were compiled according to the goalbox extinction criterion.	96
9	A summary of the analysis of variance applied to third segment (postpunishment) running speeds. The data were compiled according to the goalbox extinction criterion.	99
10	A summary of the analysis of variance applied to starting scores. The data were compiled according to the prepunishment extinction criterion.	102
11	A summary of the analysis of variance applied to first segment (prepunishment) running speeds. The data were compiled according to the prepunishment extinction criterion.	106
12	Mean trials to extinction as a function of extinction treatment and extinction criterion.	107

TABLE		PAGE
13	A summary of the analysis of variance applied to starting scores. The data were compiled according to the goalbox extinction criterion.	123
14	A summary of the analysis of variance applied to first segment (prepunishment) running speeds. The data were compiled according to the goalbox extinction criterion.	125
15	A summary of the analysis of variance applied to third segment (postpunishment) running speeds. The data were compiled according to the goalbox extinction criterion.	126
16	A summary of the analysis of variance applied to starting scores. The data were compiled according to the prepunishment extinction criterion.	129
17	A summary of the analysis of variance applied to first segment (prepunishment) running speeds. The data were compiled according to the prepunishment extinction criterion.	130
18	Mean trials to extinction as a function of extinction treatment and extinction criterion.	132

LIST OF FIGURES

FIGURE		PAGE
1	A diagram of the four combinations of modified-conventional or controlled handling procedure, and 1-sec or 16-sec starting area confinement time, given subjects during acquisition and extinction.	29
2	First segment (prepunishment) running speeds as a function of 1 sec or 16 sec starting area confinement times and regular or punished extinction conditions. The data were compiled according to the goalbox extinction criterion.	35
3	First segment (prepunishment) running speeds as a function of 1 sec or 16 sec starting area confinement times and regular or punished extinction conditions. The data were compiled according to the prepunishment extinction criterion.	37
4	First segment (prepunishment) running speeds as a function of 1 sec or 16 sec starting area confinement times. The data were compiled according to the goalbox extinction criterion.	42
5	First segment (prepunishment) running speeds as a function of controlled or modified-conventional handling procedure. The data were compiled according to the goalbox extinction criterion.	44
6	First segment (prepunishment) running speeds as a function of punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion.	47
7	Third segment (postpunishment) running speeds as a function of 1 sec or 16 sec starting area confinement time and modified-conventional or controlled handling procedure. The data were compiled according to the goalbox extinction criterion.	49
8	Third segment (postpunishment) running speeds as a function of controlled or modified-conventional handling procedures and punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion.	51
9	Starting scores as a function of modified-conventional or controlled handling procedure and punished or regular extinction conditions. The data were compiled according to the prepunishment extinction criterion.	55

FIGURE		PAGE
10	First segment (prepunishment) running speeds as a function of modified-conventional or controlled handling procedure and punished or regular extinction. The data were compiled according to the prepunishment extinction criterion.	58
11	Hypothetical fear gradients during punished or regular extinction for subjects with 1 sec and 16 sec starting area confinement times.	66
12	A diagram of the four combinations of drop or guillotine-door starting procedure and 1 sec or 16 sec starting area confinement times given subjects during acquisition and extinction.	76
13	First segment (prepunishment) running speeds of subjects in the 1 sec confinement groups as a function of drop or guillotine-door starting procedure and punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion.	80
14	First segment (prepunishment) running speeds of subjects in the 1 sec confinement groups as a function of drop or guillotine-dosr starting procedures and punished or regular extinction conditions. The data were compiled according to the prepunishment extinction criterion.	82
15	First segment (prepunishment) running speeds of subjects in the 16 sec confinement groups as a function of drop or guillotine-door starting procedure and punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion.	84
16	First segment (prepunishment) running speeds of subjects in the 16 sec confinement groups as a function of drop or guillotine-door starting procedure and punished or regular extinction conditions. The data were compiled according to the prepunishment extinction criterion.	86
17	Starting scores as a function of punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion.	89
18	Starting scores as a function of drop or guillotine-door procedure and 1 sec or 16 sec starting area confinement time. The data were compiled according to the goalbox extinction criterion.	91

FIGURE PAGE

19 First segment (prepunishment) running speeds as a function of drop or guillotine-door starting procedures and 1 sec or 16 sec starting area confinement times. The data were compiled according to the goalbox extinction criterion. 94

20 Third segment (postpunishment) running speeds as a function of drop or guillotine-door starting procedure. The data were compiled according to the goalbox extinction criterion. 97

21 Starting scores as a function of drop or guillotine-door starting procedures. The data were compiled according to the prepunishment extinction criterion. 100

22 First segment (prepunishment) running speeds as a function of drop or guillotine-door starting procedure and 1 sec or 16 sec starting area confinement time. The data were compiled according to the prepunishment extinction criterion. 103

23 First segment (prepunishment) running speeds as a function of drop or guillotine-door starting procedure and punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion. 117

24 First segment (prepunishment) running speeds as a function of drop or guillotine-door starting procedure and punished or regular extinction conditions. The data were compiled according to the prepunishment extinction criterion. 119

25 Starting scores as a function of punished or regular extinction condition conditions and guillotine-door or drop starting procedures. The data were compiled according to the goalbox extinction criterion. 121

26 Third segment (postpunishment) running speeds as a function of drop or guillotine-door starting procedures and punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion. 127

INTRODUCTION

Numerous studies have shown that under certain conditions the introduction of aversive stimulation during the extinction of an aversively motivated response sequence tends to prolong rather than suppress extinction performance. This punishment-produced augmentation or facilitation is sometimes seen as greater resistance to extinction, and sometimes as greater response vigor (higher speed or shorter latency responding) for punished than for nonpunished subjects. Behavior of this type has been called vicious-circle behavior (Mowrer, 1947), in general, or self-punitive locomotor behavior if some measure of locomotor behavior is the dependent variable.

In most of the experiments on self-punitive locomotor behavior the general procedure has been first to train subjects to perform a locomotor response to escape or avoid aversive stimulation. Following this acquisition training some of the subjects are exposed to punished extinction conditions while others undergo regular extinction. Punished extinction conditions differ from those of regular extinction in that, in the former, the presentation of an aversive stimulus is contingent upon a subject's making the formerly reinforced locomotor response while in the latter no aversive stimulation is presented at any time. In the typical experiment subjects are trained to escape aversive electric shock by traversing a straight alley. On each extinction trial the members of the regular extinction group are presented with no shock if they traverse the alley, and none is presented if they fail to do so. Subjects in the punished extinction group, however, encounter electric shock if they leave the safe starting area to traverse the alley but are not shocked if they do not leave the starting area.

Factors affecting self-punitive locomotor behavior

Numerous factors have been isolated which affect the strength of the punishment-produced response facilitation in studies of self-punitive behavior. (A complete review of the literature of self-punitive locomotor behavior is included in Appendix A.) For instance, within certain limits the strength of self-punitive behavior is positively related to the intensity of punishment during the extinction phase (Gwinn, 1949; Beecroft, Bouska, & Fisher, 1967; Imada, 1959; and Melvin & Bender, 1968). This seems to be true (for rats) within a range of shock intensities from about 0.4 ma to 1.0 ma. One consideration which limits the generality of the relation, however, is the similarity between the intensity of the punishment during extinction and that of the aversive stimulus used in acquisition. In at least one experiment (Beecroft, Bouska, & Fisher, 1967) rats punished with the same intensity shock during extinction as had been used during acquisition performed better than rats punished with a higher intensity shock.

The location of punishment in the alleyway (and therefore also within the response sequence) has also been shown to be an important factor in determining the effects of punishment during extinction. Whereas both goal shock (Babb & Hom, 1971), and pre-goal shock in various locations between the startbox and goalbox, have been shown to produce self-punitive behavior, certain positions have proved to be more effective than others. It seems that punishment received in segments of the alley closer to the startbox is more effective than punishment received in segments closer to the goalbox (Brown, Horsfall, & Van Bruggen, 1969; Melvin & Stenmark, 1969; Melvin & Bender, 1967; Melvin, Athey, & Heasley, 1965; Campbell, Smith, & Misanin, 1966; and Martin & Melvin, 1964). Both Brown (1969) and Melvin (1971), from their reviews of the self-punitive literature, surmised that punishment located in a middle segment of a runway should be most facilitating. This was based primarily on between-experiment comparisons and on an unpublished study by Brown, Horsfall, & Van Bruggen (1969). In a recent unpublished study, however, Eaton (1972) found that rats shocked in the first segment resisted extinction better than animals punished in the middle of the alley or close to the goalbox.

The percentage of trials on which punishment is presented during extinction is also an important determinant of self-punitive locomotor behavior. Greater degrees of facilitation have been observed with moderate and high than with low percentages of punishment (Bender & Melvin, 1967; Martin & Moon, 1968; Melvin, 1964; Beecroft, Fisher, & Bouska, 1967; Bender, 1969). It would appear, however, that beyond some point, perhaps 30-50%, further increases in punishment percentage have little effect on dependent measures that are not directly affected by the dynamogenic properties of shock, e.g. trials to extinction or prepunishment speed (Gwinn, 1949; Melvin & Moon, 1968).

Comparisons of the relative magnitude of punishment-produced facilitation following different types of acquisition training are hazardous because many control problems arise. Nevertheless, three studies have been reported in which such comparisons have been attempted using traditional one-way runways (Beecroft & Brown, 1967; Bender & Melvin, 1967; and Babb & Hom, 1971). The results of these experiments indicated better performance for avoidance-trained rats than for escape-trained rats. More recent experimentation (Eaton & Crowell, 1974; Eaton, 1974a, 1974b), however, has shown self-punitive behavior in a two-way apparatus following escape training only; punishment following avoidance training led to suppression in two instances. It would seem that further work is needed before any general statements can be made that encompass both one- and two-way situations.

Several studies have demonstrated that preliminary shock-escape or avoidance training is unnecessary for the production of punishment-produced response facilitation. Thus, self-punitive behavior has been observed in three experiments where rats escaped not from shock but from fear-arousing startbox cues, cues which had been previously paired with the presentation of an aversive stimulus (Melvin & Stenmark, 1968; Galvani, 1969; and Kruger, 1974). In the Galvani and Kruger studies it was also observed that the magnitude of the facilitation produced by punishment was a function of strength of fear (as defined by the number of CS-shock pairings) elicited by the startbox cues during the fear-escape phase.

It is of particular interest to note that in several studies performance increments over trials have been demonstrated during punished extinction, suggesting that self-punitive behavior need not necessarily be characterized as simply greater resistance to extinction for punished than nonpunished subjects. These performance increments, usually increased running speeds, have been described as reflecting the learning of self-punitive locomotor behavior because the speed curves sometimes resemble typical learning curves. Such effects have been reported by Melvin and Martin (1966), Whiteis (1956), Beecroft and Bouska (1967), Melvin and Smith (1967), Melvin and Stenmark (1968), and Anson, Bender, and Melvin (1969).

Although approximately equal numbers of self-punitive locomotor experiments have been performed using massed and spaced trials, in only one published study has an attempt been made to compare these two procedures directly (Williams, 1967). Williams reported self-punitive behavior with relatively short ITIs (intertrial-intervals), up to 20 min, but not with a longer ITI of 60 min. The importance of ITI was further demonstrated by Martin (1969); the interposition of an 18-min "time out" during extinction with an ITI of 30 sec radically reduced self-punitive responding. That the self-punitive effect can be obtained at very long ITIs, however, has been shown in studies by Klare (1974) and Cunningham, Brown, and Roberts (1975) in which only one trial per day was administered.

Selection of appropriate extinction criteria (as noted by Church, 1963) may also be important for the demonstration of self-punitive behavior as might the type of starting procedure used. Both extinction criteria and starting procedures will be discussed in greater detail below.

The self-punitive effect has proved to be a phenomenon of relatively great generality having occurred under a variety of different conditions, in many kinds of apparatus, and in a wide range of species. Moreover, primary punishment that is qualitatively different from the aversive stimulus used during acquisition has been shown to facilitate extinction performance (Melvin & Martin, 1966) as has secondary punishment, i.e. the response contingent presentation of a conditioned stimulus previously paired with an aversive stimulus (Bender, 1969). In addition, the aversive effects of qualitatively different aversive stimuli have been shown to be summative; two aversive stimuli presented simultaneously yield greater punishment-produced facilitation than one alone (Rollins & Melvin, 1970).

Self-punitive locomotor behavior has been demonstrated primarily with species that readily adapt to apparatus in which locomotor responses are easily measured. These species have included rats, gerbils (Martin, Ragland, & Melvin, 1970; Martin, Demmer, & McArdle, 1971) and rabbits (Martin, 1972). Analogous effects on nonlocomotor responding have been obtained, however, with a number of other species, marmosets, pigeons, squirrel monkeys, cats, dogs, and humans (as well as with rats) in a variety of situations where rate of bar-pressing, chain-pulling, wheel-turning, or hurdle-jumping was the dependent measure (Wells & Merrill, 1969; Sandler, Davison, Green, & Holzshuh, 1966; McKerney, 1968, 1969; Stretch, Orloff, & Dalrymple, 1968; Byrd, 1969; Dreyer & Renner, 1971; Fitzgerald & Walloch, 1969; and Solomon, Kamin, & Wynne, 1953).

While startbox fear level and/or a subject's discrimination of the presence of shock in the starting area are often inferred from its behavior in these experiments, few studies have provided direct indices of these factors. Klare (1974), however, using activity level in the upper holding area of his bi-level starting box as an independent measure of startbox fear, showed that self-punitive running was a function of fear while Brown (1970), Brown, Beier, and Lewis (1971), and Crowell, Brown and Lewis (1972) showed that rats performed self-punitively even though, by an independent measure, the animals discriminated the forthcoming punishment.

<u>Contemporary theories of self-punitive locomotor behavior</u>

The conditioned-fear interpretation originally offered by Mowrer (1947), and substantially modified and improved over the following years, is currently the most widely known theory of self-punitive locomotor behavior. As originally stated, the theory proposed that during the acquisition of an aversively motivated escape or avoidance response, fear becomes conditioned to the cues of the startbox and alleyway. During extinction, rats running out of the prepunishment area encounter shock, thus reconditioning fear to cues of the prepunishment and punishment areas. Since extinction performance is assumed to be motivated by fear, and fear of the prepunishment cues would be greater for punished than for nonpunished rats, the former should display the stronger tendencies to leave the prepunishment area. In addition, a subject's entry into the goalbox, if the cues therein are substantially different from those of the startbox and alleyway where shock was presented, should be accompanied by fear reduction. Goalbox cues, being dissimilar to startbox and alley cues, should elicit less fear.

Brown, Martin, and Morrow (1964) and Brown (1969) suggested certain additional conceptions which strengthened the interpretative power of the general theory. They noted that a subject's forward locomotion off the punishment zone and into the goalbox is not only secondarily reinforced through fear reduction in the goalbox, but also primarily reinforced through shock offset. In addition, since the tactile cues of the electrified grid were present during acquisition of the aversively motivated response, their presence in some portions of the alley during extinction would make the stimulus complex for punished rats more like that of acquisition than for nonpunished rats. Punished rats, therefore, would be more likely to display forward locomotor tendencies since there would be less stimulus-generalization decrement between acquisition and extinction for those subjects. In this last addition Brown has incorporated the basic idea of the stimulus-similarity discrimination hypothesis which is mentioned separately below. Finally, to the extent that the presentation of the primary aversive stimulus, usually shock, during punished extinction increases the subject's drive level (i.e. has direct dynamogenic effects) one would expect facilitation of any responses elicited in the presence of shock. Thus, if forward locomotion is the dominant response for both punished and nonpunished rats in a certain segment of an alleyway, but the grid is electrified for only punished rats, then punished rats, having a higher general drive level, would be expected to display higher running speeds in that segment.

Brown also noted that shock-zone location seems to be a significant variable in studies of self-punitive behavior and suggested three factors of possible importance which are functions of shock-zone location. The first is the delay of punishment following the initiation of the response sequence, the second is the length of the response sequence, and the third is the "CS-US" interval (the temporal interval between the presentation of the conditioned stimulus and the unconditioned stimulus) for the reconditioning of fear to startbox cues.

If short delays of punishment, resulting from shock near the startbox, are more suppressive than long delays, but fear conditioning is better with short CS-US intervals, resulting from near shock, then shocks in the middle position may offer the most efficacious compromise for the production of self-punitive behavior.

Melvin (1971) added to the general theory a model of conditioned fear designed to handle the effects of shock-zone location. He proposed that during punished extinction fear is reconditioned with greatest strength to cues of the area where shock is presented. Generalized fear is elicited by other cues in inverse proportion to their distance from the punishment zone. Such a notion would lead one to expect more vigorous responding in the area where subjects were punished than in other locations, and more prolonged extinction performance for subjects punished close to the startbox than close to the goalbox. In addition, the theory leads to the prediction that subjects receiving punishment in several different locations should display the best overall alleyway performance because fear would be directly conditioned to cues in every segment. A recent unpublished Master's thesis (Eaton, 1972) has supported this interpretation.

Although Melvin's notion seems to handle the shock-zone location data quite well, his interpretation has not been strongly supported by studies in which the shock zone was made distinctive. Although decreased performance might have been predicted, making the shock zone distinctive has led to improved performance in one study (Brown, 1970, Experiment 2), but had no reliable effect in two others (Brown 1970, Experiment 1, and Brown, Beier, & Lewis, 1971).

Two major alternatives to the Mowrer-Brown theory of self-punitive behavior have been suggested. The first stems from Church's (1963) mention of the physical similarity between the conditions of acquisition and those of punished extinction. This has been referred to as the "stimulus-similarity discrimination hypothesis" and does not necessarily require appeal to cognitive processes. Instead, it holds that a subject's performance during extinction is a function of the similarity between extinction and acquisition conditions. Punished subjects would be expected, therefore, to resist extinction better than unpunished subjects because punished extinction is more like escape or avoidance acquisition than is regular extinction. However, several experiments have shown that marked changes between acquisition and extinction may lead to better performance during extinction than smaller changes (Gwinn, 1949; Melvin, Athey, & Heasley, 1965; Melvin, 1964; Beecroft & Bouska, 1967; Bender, 1969). In addition, the stimulus-similarity conception, alone, is unable to explain the instances wherein performance is better during punished extinction than at the end of acquisition.

The third interpretation of self-punitive behavior, a cognitive discrimination hypothesis, has been championed by Mowrer (1960) and Dreyer and Renner (1971). According to this theory, organisms respond self-punitively because they are unable to discriminate between the shocked and unshocked portions of the alleyway during punished extinction. They are unable to determine that shock is not present in the prepunishment sections of the alley, and that it is their forward locomotion that leads them to be punished.

In general this theory seems to be of limited utility since seldom has there been provided any independent measure of response-punishment contingency discrimination (other than performance during extinction, the very behavior that the cognitive discrimination hypothesis is supposed to explain). Although the behavioral laws are only implied, it seems to be generally supposed that once a subject has discriminated the response-punishment contingency during punished extinction, it will behave rationally, cease to punish itself, and remain in the prepunishment sections of the alley. However, since numerous examples of human irrationality could be mentioned, it seems "irrational" necessarily to require that rats should always behave rationally. Finally, like the stimulus-similarity discrimination hypothesis, the cognitive discrimination conception cannot explain performance increases during punished extinction. If a subject is completely unable to discriminate between acquisition and punished extinction, no change in performance, not improved performance, would be expected.

A fourth interpretation recently proposed by Delude (1973, 1974) is that self-punitive behavior may be an artifact of the frequently used drop-starting procedure. Delude's ideas and experiments, as well as a pertinent experiment by Delprato and Meltzer (1974) are discussed in the following section.

<u>Introduction to the specific problem area</u>

This section is devoted to an analysis of the experiments dealing with, and the procedural differences between, drop starting and guillotine-door starting procedures used in studies of self-punitive locomotor behavior. Drop starting procedures are those in which an animal is placed in the upper holding area of a bi-level startbox located at one end of a straight alleyway. After some period of time the trapdoor-floor of the upper holding area is released dropping the subject into the starting area from which it can traverse the alley and enter the goalbox. Guillotine-door starting procedures are those in which the subjects are placed directly into the starting area of the alleyway at the beginning of each trial. The starting area, however, is separated from the alleyway by a guillotine door. After some period of time the door is raised permitting the subject to run to the goalbox.

It has been recently suggested (Delude, 1973, 1974; Delprato & Meltzer, 1974) that the kind of starting procedure one uses can be of critical importance in studies of self-punitive behavior. The laws one would obtain with one procedure, therefore, would be different from those obtained with the other. The following is a detailed discussion of the experiments by Delude, and Delprato and Meltzer, and their interpretations of the results. Also included is a critical assessment of their possible implicit manipulations of critical variables, which, it would seem, could have substantially affected the results of their experiments and, therefore, their interpretations.

In 1973 Delude reported a study in which a 2 x 2 factorial design was used with punished vs. regular extinction as one factor and training and extinction with the guillotine-door starting procedure or the drop starting procedure as the second factor. Delude's apparatus was a 4-ft (122 cm) alley with a 1-ft (30.5 cm) starting area and a 1-ft (30.5 cm) goalbox, both separated from the alley by guillotine doors. The starting area was surmounted by a trapdoor-floored holding compartment, thus forming a traditional bi-level starting box. The alley, starting and holding areas, and goalbox, were painted black; the starting area and alley had grid floors while the goalbox had a wooden floor. Following 10 escape (0.5 ma) trials, at an ITI (inter-trial-interval) of 30 sec, extinction conditions were instituted. Rats in the regular extinction groups encountered no shock in the alley while those in the punished groups encountered 0.5 ma shock in the second 1-ft (30.5 cm) segment. Extinction trials were given until the rats had reached one of three criteria of extinction: (1) failure to enter the goalbox within 30 sec on one trial, (2) failure to leave the prepunishment zone within 30 sec on one trial, and (3) failure to leave the startbox within 30 sec on three of five consecutive trials. Delude separately compared the guillotine-door punished group with the guillotine-door nonpunished group, and the drop-start punished group with the drop-start nonpunished group. He noted that neither comparison of trials to extinction (by the third extinction criterion) reached acceptable levels of significance. Analyses of trials to extinction data, in terms of the first two extinction criteria, were not reported. Both drop-start groups, however, ran more trials to extinction than guillotine-door groups, and drop-start rats demonstrated punishment-produced response facilitation in terms of prepunishment running speeds while those in the guillotine-door groups did not. Unfortunately Delude did not specify which extinction criterion he used in reporting his prepunishment speed data.

Delude concluded that the effect of punishment upon extinction is strongly affected by the type of starting procedure employed, and that the difference between procedures is due to innate fear generated by the drop-starting procedure. Self-punitive responding should occur when the drop-starting procedure is used or when the guillotine-door procedure is used in conjunction with a CS having unconditioned aversive properties, such as a noxious buzzer. Self-punitive responding should not occur, however, when the guillotine-door procedure is used alone.

In his interpretation, Delude apparently failed to take into account several important features of his experiment. First, his goalbox was similar to the starting area and alley, in both color and size. Such conditions, by the conditioned-fear interpretation, would be expected to attenuate self-punitive running because the degree of secondary reinforcement through fear reduction coincident with a rat's entering the goalbox would be reduced. Second, rats in the guillotine-door and drop-start groups spent unequal times in the starting area of the apparatus. The guillotine-door groups were confined there for some unspecified period of time. This probably would have been several seconds or more since Delude waited until his drop-start rats had oriented toward the goalbox before dropping them from the holding area into the startbox and presumably would have followed a comparable procedure with the guillotine-door rats. Rats in the drop-start groups, however, were allowed to traverse the alley immediately after being dropped. Conditioned fear elicited by startbox cues, therefore, could have extinguished faster for rats in the guillotine-door groups than for those in the drop-start groups. His conclusion that self-punitive behavior occurs when aversive starting procedures, like the drop-starting procedure, are used, but not with more neutral starting procedures like the guillotine-door procedure, might then have been biased by his use of less than optimal experimental conditions and probable confounding of startbox confinement time and starting procedure.

Although he did point out that some experiments using the guillotine-door procedure have reported self-punitive behavior, he expressed concern because a buzzer CS was used in those studies. He argued that the buzzer may not have been a legitimate CS because it may have initially had unconditioned aversive properties. We should note, however, that in several studies (Martin & Melvin, 1964; Martin & Moon, 1968; Delude, 1969; and Martin, Ragland, & Melvin, 1970) no buzzer was used but self-punitive behavior was demonstrated. It is not clear whether Delude chose to discount these because their authors used the traditional extinction criterion, failure to enter the goalbox. He has consistently championed the use of extinction criteria based on performance in preshock alley sections.

In a second report, Delude (1974) again proposed that the lack of consistency of results in studies of self-punitive behavior is due to the use of different starting procedures. Delude noted that Brown (1969) had suggested that being dropped provides unusually salient external and proprioceptive stimuli to which both running and fear could be conditioned. Thus, rats run with the drop-start procedure might display better extinction performance, and greater punishment-produced facilitation, than rats run with the guillotine-door procedure. Salient cues to which fear and running could be conditioned would occur for rats run with the former procedure but not for those with the latter. As an alternative, Delude said that falling when the trapdoor-floor is opened generates innate (unconditioned) fear sufficient to maintain abient responding. He argued that if the conditioned fear notions were correct, shifting from the guillotine-door procedure during acquisition to the drop-start procedure during extinction would lead to a decrement in extinction performance because cues of the drop-start procedure, which have never been made contiguous with shock and which, therefore, would not elicit conditioned fear, would be introduced. From Delude's arguments, however, one would predict that such a shift in starting procedure would lead to improved performance because innate fear "sufficient to maintain abient responding" would be introduced.

In his second study Delude used the same apparatus described previously (Delude, 1973) and again failed to specify starting area or holding area confinement times. His rats were assigned to one of three groups. One group was trained and extinguished with the drop-start procedure, a second was trained with the guillotine-door procedure and extinguished with the drop-start procedure, while a third was trained and extinguished with the guillotine-door procedure. All rats were punished during extinction; shock was presented in the second 1-ft (30.5 cm) of the alley. Extinction trials continued until each rat had completed 60 trials or until it failed to leave the startbox within 30 sec on 3 out of 5 consecutive trials. Four rats (out of five per group) in the groups extinguished using the drop-start procedure were still running at the end of training whereas only one rat in the group extinguished with the guillotine-door procedure had not extinguished. Mann-Whitney tests showed that the first two groups did not differ reliably in trials to extinction but both differed from the third. Starting-speed scores reflected similar relationships.

Delude concluded that the data supported his innate fear interpretation of self-punitive behavior but not Brown's conditioned fear interpretation which he described as placing emphasis only on the greater saliency of the drop-start cues. In addition, Delude again set forth his notions of self-punitive behavior, which, in summary, appear to be as follows. The phenomenon is specific to, and dependent upon, situations in which the starting procedure employed has sufficient unconditioned aversive properties to somehow propel the organism from the starting area and presumably into and through the punishment zone. Contributing to the self-punitive effect is the fact that once into the punishment zone punished subjects are given the additional impetus from the charged grid to speed out of the punishment zone, and into the goalbox. Nonpunished subjects, without this "boost", are less likely to enter the goalbox, and therefore more likely to meet the traditional extinction criterion (of one failure to enter the goalbox). Self-punitive behavior, therefore, would not be expected if a starting procedure lacking unconditioned aversive properties were used.

In evaluating the procedures and results of his second experiment we should again note that, because the alley, startbox, and goalbox were the same color and size, conditions would not have been optimal for the demonstration of self-punitive locomotor behavior for subjects in any of the groups. Delude claimed that for rats trained with the guillotine-door procedure but extinguished with the drop-start procedure, the drop cues would elicit no conditioned fear. These drop cues, however, would have been paired with the onset of shock in the alley when the rat ran forward, as all rats did on the first punished extinction trial.

Drop cues, then, preceded shock onset, and could have elicited fear in the startbox after the first extinction trial. We should note again that rats in the groups extinguished with the drop-start procedures were not confined to the startbox before each trial as were rats in the group extinguished with the guillotine-door procedure. Thus, during the punished extinction phase of the experiment there would have been less extinction of fear and/or locomotor responding to startbox cues for rats in the former groups than for those in the latter. Better extinction performance for rats in the drop-start groups than for those in the guillotine-door groups would have been expected, therefore, from both a conditioned-fear and an innate-fear interpretation. Finally, since there were no unpunished controls, one has no way of knowing whether the experiment indeed demonstrated self-punitive behavior.

An evaluation of Delude's conceptions of self-punitive behavior, however, is not so clearcut. It would certainly be more parsimonious to be able to include the self-punitive effect in the set of phenomena thought to be governed by the principles of learning and motivation, following some motivational-associative interpretation such as the Mowrer-Brown theory. The data, however, appear to be ambiguous, and while confounded by the confinement-time factor, even supportive of Delude's position. There seem to be no published experiments using the guillotine-door procedure unaccompanied by unconditioned aversive stimuli in which the self-punitive phenomenon was demonstrated in terms of Delude's favored prepunishment dependent measure and extinction criterion.

In the final study to be reviewed (Delprato & Meltzer, 1974) drop-start and guillotine-door procedures were again compared. These investigators noted that one difference between many of the studies in which self-punitive behavior has been demonstrated, and those in which it had not, is that in the former the drop-starting procedure was used, and that in the latter the guillotine-door starting procedure was used. Their experiment was designed to provide a presumably unconfounded comparison of the two procedures. They used an apparatus with a 4-ft (122 cm) white alley, an oversized black goalbox, and either a guillotine-door or drop-startbox. After confinement for 5 sec, in the upper holding area of a bi-level startbox for rats in the drop-start group, or in the starting area for those in the guillotine-door group, each trial began. Fifteen shock-escape acquisition trials were followed by extinction trials; on all trials the rats remained in the goalbox throughout the 30 sec ITI. Half of the rats trained with the guillotine-door procedure, and half with the drop-start procedure, were then given no-shock regular extinction trials, while the remaining animals were administered punished extinction trials. On such trials, shock was present in the middle 61 cm of the alley. Each rat was run for 75 consecutive trials or until it failed to leave the prepunishment area on 3 consecutive trials.

Prepunishment speeds were higher for punished members of the drop-start groups than for nonpunished rats, but were slightly lower for the punished animals in the guillotine-door groups than for non-punished rats. Neither starting speeds nor trials to extinction data were reported.

Delude and Meltzer suggested three ways in which the drop-start method might have produced more fear (to motivate running) than the guillotine-door procedure: (1) the unconditioned response to the drop might have contained a fear component, (2) the CS complex paired with shock might have been more intense or salient with the drop-start procedure, or (3) confinement of the rats in the guillotine-door groups to the lower startbox prior to the beginning of each trial might have permitted more fear extinction than confinement of rats in the drop-start groups to the upper startbox before each trial.

Again, it would seem, the comparison of drop starting and guillotine-door starting procedure was confounded by differential durations of starting area exposure, and that no definitive solutions to the problems addressed were provided. In the following experiments an attempt has been made to clarify the relative contributions of starting area confinement, starting procedures, and extinction criteria on the production of the self-punitive effect. The first experiment addresses the specific question, "What are the effects of startbox confinement time on self-punitive behavior when a guillotine-door procedure is employed?" The second and third studies involve comparisons of the two starting procedures using experimental designs which are unconfounded by the confinement variable. In each study outcomes based on both prepunishment and postpunishment extinction criteria are evaluated.

EXPERIMENT 1

Introduction

As has been noted above, Delude, as well as Delprato and Meltzer, obtained the self-punitive phenomenon when animals were extinguished with the drop-start procedure, but not when they were extinguished with a guillotine door. It would seem appropriate therefore, to attempt to determine why they obtained no self-punitive behavior while others using that starting procedure obtained the effect (Martin & Melvin, 1964; Martin & Moon, 1968; Martin, Ragland, & Melvin, 1970; and Martin, 1969). One approach which could prove fruitful is that which explores difference in startbox confinement times between the two procedures and therefore differences in the extinction of fear and/or locomotor responding to startbox cues. A second possibility is that the use of different extinction criteria in experiments wherein self-punitive behavior was demonstrated, and those where it was not, could have been important.

Several studies have shown a relationship between fear of the startbox and self-punitive running (Mevlin & Stenmark; 1968; O'Neil, Skeen, & Ryan, 1970; Galvani, 1970; Kruger, 1974; and Cunningham, Brown, & Roberts, 1975). One obvious difference between the guillotine-door and drop starting procedures is that rats run with the former are confined in the starting area for an appreciable period of time before each trial. In the Delprato and Meltzer study this period was 5 sec; in the Delude studies it was not reported. Rats which were started with the drop procedure, however, when dropped from the upper holding area, were able to traverse the alley immediately. Thus, as has been suggested by O'Neil, Skeen, and Ryan (1970), Delprato and Meltzer (1974) and Crowell (1974), rats started with a guillotine-door procedure are exposed for a relatively long period of time prior to each trial to starting area cues while rats run with the drop-start procedure are exposed for only a very short time. Variations in duration of exposure to the startbox cues prior to each trial could have several effects. First, the longer the exposure without presentation of shock (the US for fear conditioning) the more likely fear would be to extinguish to these cues. Thus, fear, thought to be the primary source of motivation during extinction, would be reduced. Fear is also assumed to provide internal feedback stimuli to which responses could be conditioned. Reductions in fear, therefore, would change the stimulus complex that elicits forward locomotion and, through stimulus generalization decrement, weaken that response. Secondly, the longer the startbox cues are presented while the rat is confined, the less likely, overall, are these cues themselves to elicit the response when the rats are permitted to run. Finally, since increased startbox confinement times should produce both a decreased tendency to run and (assuming little motivational increment due to frustration) decreased motivation due to fear extinction, the observed forward locomotor response should be weakened.

These considerations lead to the prediction that rats extinguished without shock, and with long startbox confinement times, should stop running sooner than those with a shorter confinement time. In addition, if the stronger the response, the more likely it is to be facilitated by shock during extinction (Brown, 1969), it is also predicted that rats with short confinement times should demonstrate more self-punitive behavior than those with long startbox confinement times.

A self-punitive study using a guillotine-door starting procedure could be performed in which startbox confinement times are varied. Conventional procedures could be employed, the rats being placed into the startbox the appropriate time before the raising of the guillotine-door. Such an experiment would address the question of whether variations in startbox confinement time, from one experiment to another, might be responsible for some of the variations in the subjects' responses to punishment that have been noted in the literature. In such an experiment, however, the extinction of fear and forward locomotor responding attributed to startbox confinement time would be perfectly confounded with the time since the rats were placed into the startbox. The required handling might have unconditioned aversive properties and serve to increment the rats' drive level for a short period of time. Alternatively, handling could provide very salient stimulation to which forward locomotor responses could be conditioned. Thus, any differences between rats given short and long startbox confinements might be attributable to the time since handling, to the extinction of fear, to the extinction of the running response, or several of these.

These sources of confounding can be overcome by following controlled handling procedures by which rats are handled the same number of times, and at the same time intervals prior to the beginning of each trial. They could thereby be exposed for different durations to startbox cues, but be handled in ways that did not confound startbox confinement time and time since handling. Thus, the problem of extinction of fear and/or locomotor responses by exposure to startbox cues could be addressed relatively directly. The use of such a procedure, however, would not answer the question of the extent to which the more commonly employed procedures, which confound startbox exposure and time since handling, determine the different effects of punishment which have been observed.

One way to consider both problems at once is to incorporate the two handling procedures into the experimental design as a factor, along with punished and regular extinction conditions, short or long startbox times, and days of extinction. Such a design would allow for a direct test of whether variations in startbox confinement time, and time since handling, might have been responsible, in part, for the varied effects of punishment that have been reported. In addition, it would be possible to evaluate some of the factors of which the effects of punishment are a function. An interaction, in the appropriate direction, between extinction condition and startbox confinement time, would indicate the importance of short confinement times for the production of punishment-produced facilitation. A higher-order interaction, between these factors and handling procedure, would allow for the assessment of the motivational-associative properties of handling as compared to those of the extinction of fear or locomotor responding.

The data from such an experiment could not provide a definitive explanation of many failures to obtain self-punitive behavior with the guillotine-door procedure, however, unless compiled in two separate ways, and the results compared. In several recent studies of self-punitive behavior, including those by Delude and by Delprato and Meltzer discussed above, a departure has been made from the use of the traditional extinction criterion of one failure to enter the goalbox.

Although not explicitly stated in these terms the response of leaving the startbox and traversing the prepunishment segment of the alley was treated as the punished response. Thus, new extinction criteria were developed, based on behaviors occurring in the starting or prepunishment areas of the alley. It is unclear whether self-punitive behavior would have been demonstrated in terms of running speeds based on the more familiar criterion of one failure to enter the goalbox. It has been noted in the literature several times (Delude, 1969, 1973) that, over extinction trials, punished subjects typically demonstrate an increasing probability of remaining (for some fixed period of time) in the prepunishment sections of the alley while nonpunished rats do not. Instead, nonpunished subjects typically demonstrate an increasing probability of failure to enter or remain in the goalbox. Thus, an extinction criterion based on postpunishment behavior could tend to favor the demonstration of the self-punitive effect while an extinction criterion based on prepunishment behavior might not. In those experiments where self-punitive behavior was convincingly demonstrated under conditions appropriate to this discussion, the goalbox criterion was used. Of course, there is no immediate reason to believe that the use of one criterion or another would differentially affect the magnitude of the self-punitive effect for drop-start and guillotine-door rats. Differential performance of self-punitive running between drop-started rats and guillotine-door rats could only be attributed to differential startbox confinement time or intrinsic properties of the procedures themselves.

It would seem, then, that either the use of the somewhat unconventional prepunishment extinction criterion, the rather long startbox confinement times, or perhaps some combination of these could have accounted for the failure by Delude and by Delprato and Meltzer to demonstrate self-punitive behavior with the guillotine-door procedure, and for their suggestion that self-punitive running does not readily occur with that procedure. In the following experiment, in which the guillotine-door procedure was utilized, locomotor performance during the extinction of an aversively motivated response was investigated. Its purpose was to determine the effects on such behavior of the presence of punishment in the alley, the type of handling procedure, the starting area confinement time, and/or the extinction criterion.

Method

Subjects. The subjects were 108 naive female albino rats (Sprague-Dawley derivatives from Charles River, Inc., Wilmington, Mass). They were 65-75 days old at the beginning of the experiment and weighed between 182 gm and 234 gm. They were individually housed in quarters illuminated only between 6 a.m. and 6 p.m. daily, and were maintained on an ad lib schedule of food and water.

Apparatus. The apparatus consisted of a grid-floored runway, a grid-floored startbox, and a smooth-floored goalbox. The startbox and goalbox were separated from the alley by guillotine doors. The startbox was 30.5 cm long, 20.3 cm high, and 11.4 cm wide, the alley was 183 cm long, and the same height and width as the startbox, while the large goalbox was 45.7 cm long, 25.0 cm wide, and 19.9 cm high. The walls and floor of the goalbox were painted with black and white squares

(2.54 cm on a side) in a checkerboard pattern. The walls of the runway, the startbox, and the subflooring beneath the grid were painted medium gray. Hinged clear Plexiglas lids covered the startbox, alley, and goalbox. The grid floor was made of 2.4-mm diameter stainless steel rods spaced at 1.27 cm intervals. Photocells and infrared light sources, located at the beginning of the runway and at intervals of 61 cm thereafter, served in conjunction with ancillary devices to provide measures of starting and running speeds in each of the three 61-cm runway segments.

The 60-Hz shock was controlled by a variable-voltage autotransformer and was fed to the grid through a series resistance of 10 K ohms. Shock voltages were measured at the grid with a dummy load of 100 K ohms simulating a rat. The voltmeter, which remained in the circuit at all times, had a full scale calibration of 150 v and a sensitivity of 2000 ohms/volt.

Procedure. The general procedure consisted of shock-escape training, followed by regular or punished extinction, with either short (1 sec)* or long (16 sec) startbox confinement, and either a controlled handling procedure or a modified-conventional handling procedure. Each trial began when the startbox guillotine-door was raised, and terminated when the goalbox guillotine door was lowered. Following 25-30 sec of goalbox confinement the rats were removed to a multiple-compartment carrying cage. Four trials per day were administered with an ITI of 35-50 min. During extinction there was no shock anywhere in the apparatus for rats in regular extinction groups but shock was present in the middle 61-cm segment for rats in the punished extinction groups.

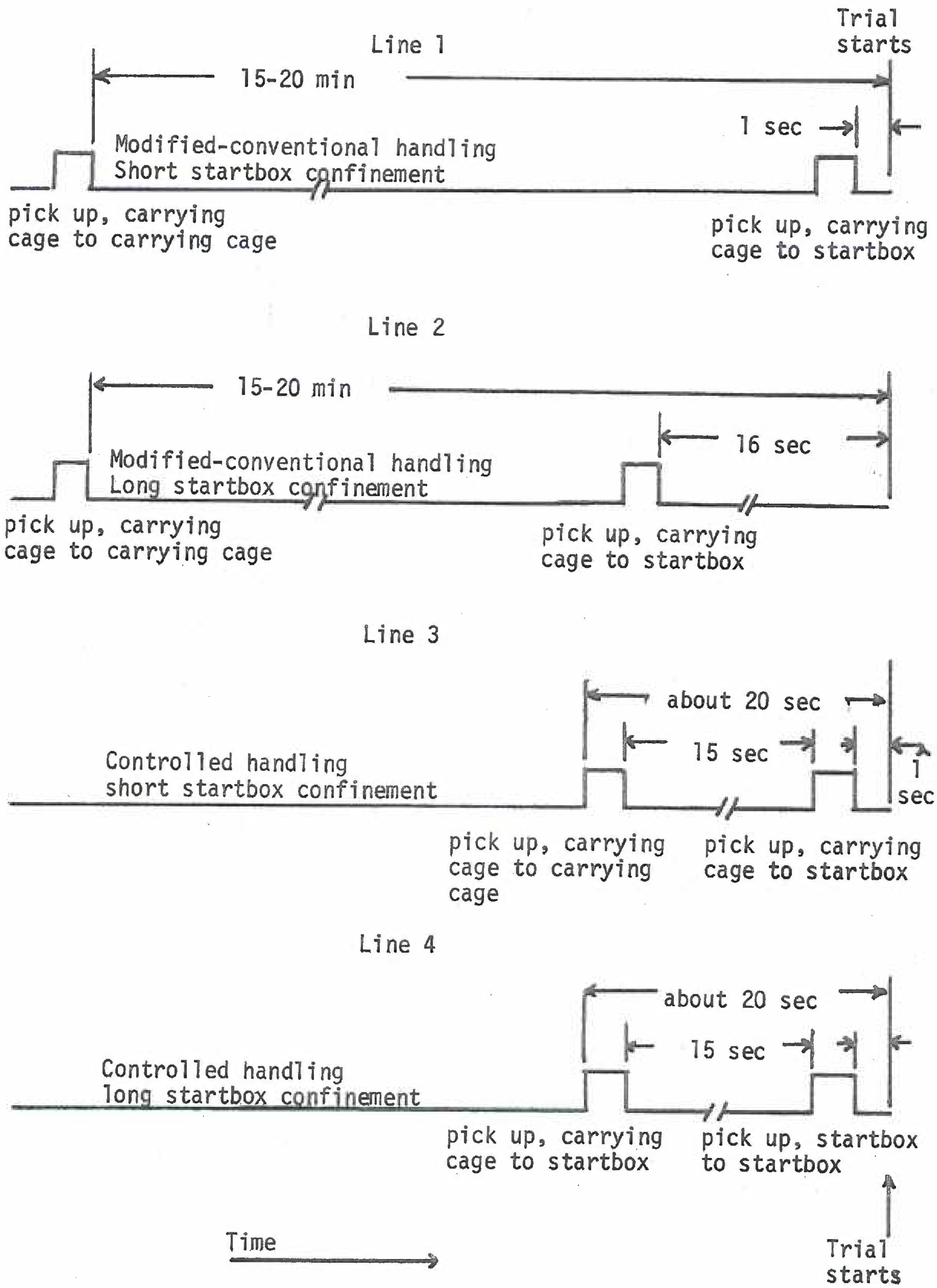
* Handling error was $\pm$ .25 sec for all startbox confinement times.

Figure 1 diagrams the treatment given the rats in the different handling and confinement-time subgroups. Each rat in the modified-conventional handling groups (Line 1 and 2) was picked up 15-20 min prior to the beginning of each trial, placed on the experimenter's arm, and immediately returned to the carrying cage for the remainder of the ITI. This handling, which is not commonly given in conventional handling procedures, equated the "modified-conventional" and the controlled procedures (described below) in terms of overall number of handlings. Rats in the short confinement group (Line 1) were placed in the startbox for 1 sec prior to the beginning of the trial while those given long startbox confinements (Line 2) were placed into the startbox 16 sec prior to the beginning of a trial. Rats given the controlled handling procedures and short startbox confinement (Line 3) were taken from the carrying cage about 20 sec prior to the beginning of a trial, placed on the experimenter's arm, and immediately placed in the carrying cage. Fifteen seconds later they were removed from the carrying cage, and placed into the startbox to await the beginning of the trial 1 sec thereafter. Those with long startbox confinements (see Line 4) were picked up about 20 sec prior to the beginning of a trial and placed in the startbox for 15 sec. They were then picked up and immediately returned to the startbox 1 sec before the beginning of the trial. Thus, duration of exposure to starting area cues is confounded with time-since-handling in the modified-conventional procedure, but not with the controlled handling procedure.

On Day 1 of the experiment each rat was handled for 2 min after which it was weighed and its tail was marked with a "Magic Marker."

Figure 1. A diagram of the four combinations of modified-conventional or controlled handling procedure, and 1 sec or 16 sec starting area confinement time, given subjects during acquisition and extinction.

Figure 1


Line 1
Trial starts
15-20 min
1 sec
Modified-conventional handling
Short startbox confinement
pick up, carrying cage to carrying cage
pick up, carrying cage to startbox
Line 2
15-20 min
16 sec
Modified-conventional handling
Long startbox confinement
pick up, carrying cage to carrying cage
pick up, carrying cage to startbox
Line 3
about 20 sec
15 sec
1 sec
Controlled handling
short startbox confinement
pick up, carrying cage to carrying cage
pick up, carrying cage to startbox
Line 4
about 20 sec
15 sec
Controlled handling
long startbox confinement
pick up, carrying cage to startbox
pick up, startbox to startbox
Time
Trial starts

This procedure took place at the hour at which experimentation was scheduled to begin each day. On Days 2-4 all rats received shock-escape training involving progressively longer segments of the runway and increasing shock intensities. On Day 2 the startbox was placed next to the goalbox and the shock intensity was set at 40 v. On Day 3 the rats had to traverse an additional 61 cm of alley to reach the goalbox and the shock intensity was increased to 45 v. On Day 4 the length of the electrified grid between the startbox and goalbox was increased to 122 cm; the shock intensity remained at 45 v. On Day 5, and all days thereafter, the full 183-cm alley separated the startbox and goalbox, and the shock, when present, was 50 v. On Days 5, 6, and 7 full-alley shock-escape trials were given. Each of the four possible combinations of startbox confinements times and handling procedures was used, in randomly determined order for each rat, on each of the four daily trials on Days 2-7. At the end of extinction, therefore, all animals had been given equivalent training. Moreover, the degree of stimulus generalization decrement, as the animals were switched to their extinction confinement time and handling procedure, would also have been equal.

Pilot work indicated that rats exposed to the guillotine-door procedure during acquisition, especially when confined for long intervals prior to a trial, sometimes learned specific postures that minimized the unscrambled shock. Distributions of startbox latencies revealed "runners" and "posturers." The majority of the rats, the "runners," had starting latencies of 5 sec or less, while a few rats, the "posturers" had average latencies of 10, 20, or even 25 sec. Pilot work indicated that the "posturers," which were arbitrarily defined as rats with latencies longer than 5 sec, typically ran few, if any, trials during extinction, and therefore had a substantially lower probability of receiving the experimental treatment than "runners." "Posturers," therefore, were discarded from the population of rats run on the final day of acquisition (Day 7) and from which rats were randomly assigned to the eight extinction treatment conditions. When more "runners" than were required for a given replication were available following Day 6, the required number were randomly selected, and the remainder, along with the "posturers" were discarded.

On Day 8 rats were assigned to one of the eight punished and regular extinction groups. Rats in one group in each of the extinction conditions were administered all extinction trials with one of the four combinations of startbox confinement time and handling procedure. Extinction continued, four trials per day, until each rat had met both extinction criteria or completed 8 days of extinction. One extinction criterion was failure to leave the prepunishment (first 61-cm) segment within 60 sec on one trial, and the other was failure to enter the goal-box within 60 sec.

The experiment was run in three replications. In the first, 20 rats were given acquisition training and 4 were eliminated as "posturers." The remaining 16 were given the final day of acquisition training and then randomly assigned, 2 per group, to each of the 8 treatment groups. In the second and third replications, 44 rats were given the initial acquisition training. After Day 6, 32 "runners" were administered the final day of escape training. They were then randomly assigned, 4 per group, to each of the 8 treatment groups, and given extinction trials.

Although there were more rats in the second and third replications than in the first, the ITI was held constant at 35-50 min in each replication.

Results

Escape Acquisition. Mean starting scores, first 61-cm alley segment speeds, and third 61-cm segment speeds were calculated for each rat for the last day of escape training. The scores were then subjected to 2 x 2 x 2 factorial analyses of variance having as pseudofactors the three extinction treatment dichotomies: punished vs. regular extinction, 1- vs. 16-sec confinement duration, and modified-conventional or controlled handling.

The results indicated no reliable differences between groups, and no interactions, for either starting scores or first segment running speeds. Running speeds in the third segment, however, were slightly greater for subjects in the controlled handling group than the modified-conventional handling group ($F=4.03$, $p=.039$).

Extinction. Mean starting scores, and preshock (first segment) and postshock (third segment) running speeds were calculated for each rat on each day using the goalbox extinction criterion for one set of scores, and the prepunishment criterion for another. For the former, on the first trial that a rat failed to enter the goalbox, and on every trial thereafter, it was assigned a starting score of .07 and running speeds of 4.1 cm/sec in the preshock and postshock segments. These values were chosen by dividing the maximum allowable time in the alley, 60 sec, by the number of alley segments, four. The reciprocal of that quotient (.07) was taken as the minimum starting score. The reciprical was then multiplied by the length of each alley segment (61 cm) yielding minimum speed scores of 4.1 cm/sec. Scores thus obtained comprised the set of data compiled in the "traditional manner," in terms of the extinction criterion of one failure to enter the goalbox.

Second, the data were also compiled in terms of the extinction criterion of one failure to leave the prepunishment segment of the alley. Similar to the compilation of the data according to the goal-box criterion, if a subject failed to leave the prepunishment zone on a particular trial, it was assigned a starting score of .07 and a prepunishment speed of 4.1 cm/sec for that trial and every trial thereafter.

A. A priori statistical tests. One major prediction of this experiment was that rats in the 1-sec confinement groups would demonstrate reliably greater punishment-produced response facilitation (in terms of running speeds) than those in the 16 sec groups. The anticipated outcomes were that: (1) punished rats in the 1-sec groups would not slow down as much over extinction days as would nonpunished rats, (2) punished rats in the 16-sec group would slow down as much over extinction as their nonpunished counterparts, and (3) the difference between the slowing down of punished and nonpunished rats in the 1-sec group would be greater than that for rats in the 16-sec group. These expectations were confirmed both by visual inspection of the data (shown in Figures 2 and 3) and by statistical analyses. Direct statistical tests of this prediction were conducted for prepunishment running speeds with each extinction criterion, using the three-way interaction contrast for time (1- vs. 16-sec confinement), punishment (regular vs. punished extinction), and extinction days (the first vs. the last extinction day). This interaction contrast is shown below.

Figure 2. First segment (prepunishment) running speeds as a function of 1 sec or 16 sec starting area confinement times and regular or punished extinction conditions. The data were compiled according to the goalbox extinction criterion.

FIGURE 2

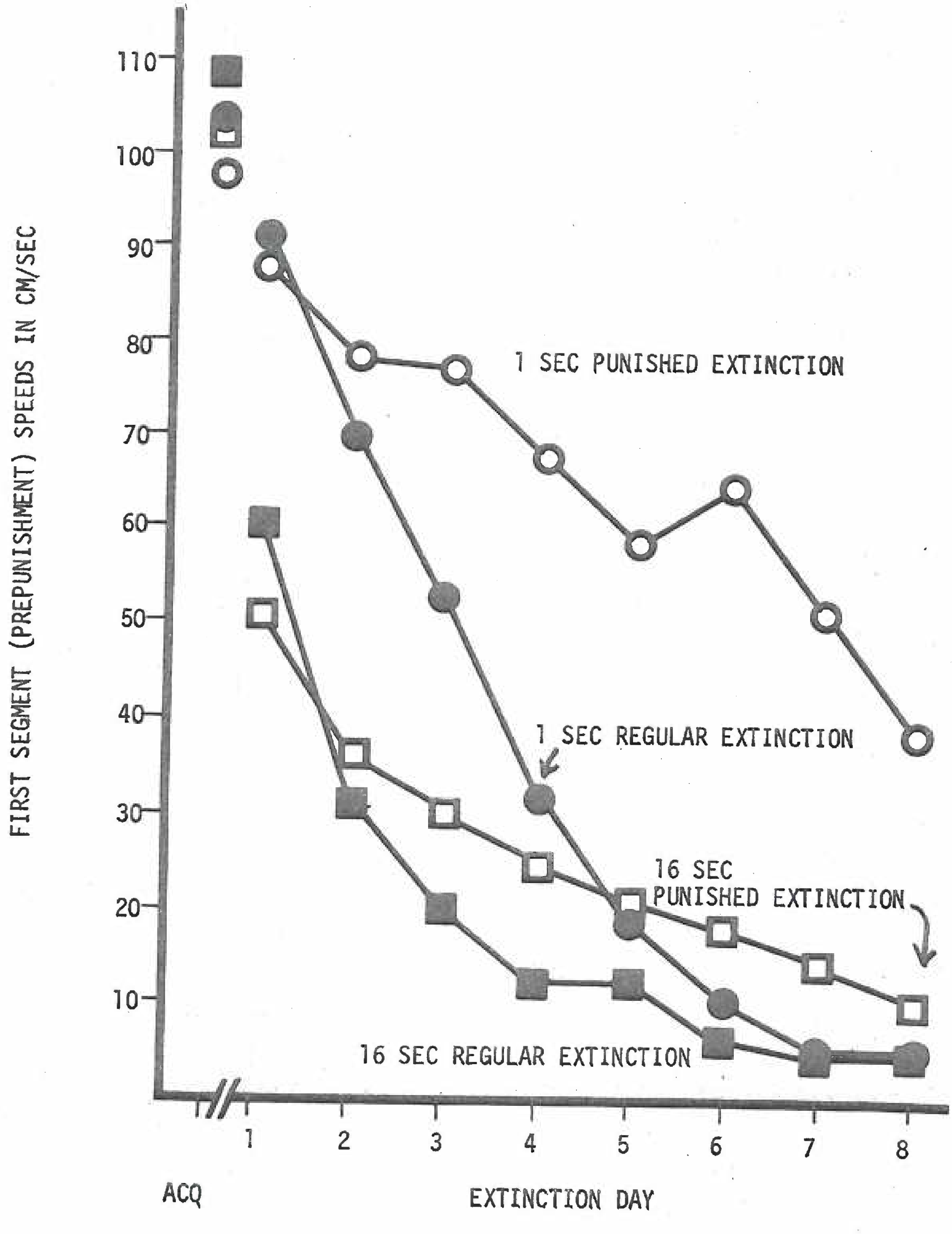
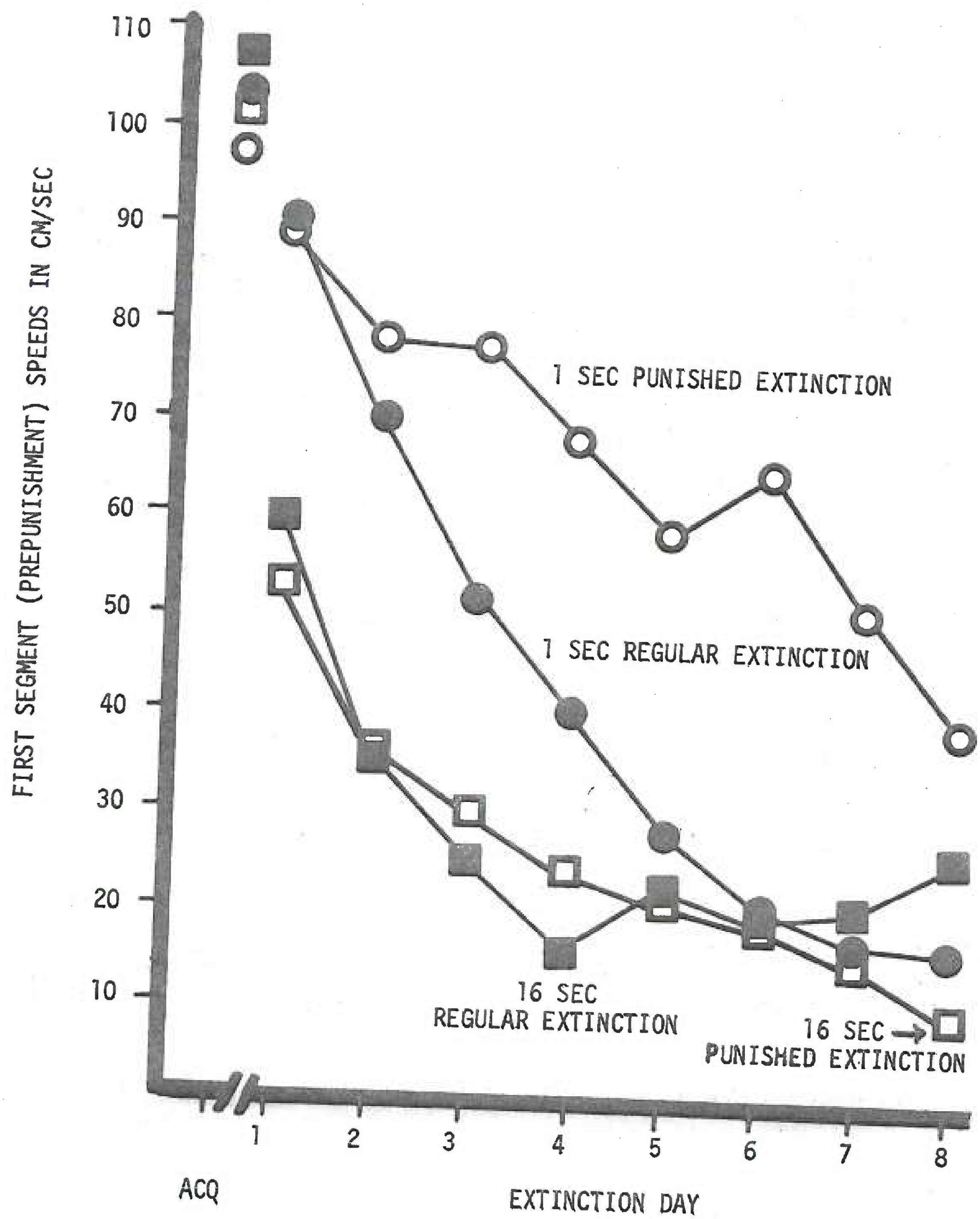

FIRST SEGMENT (PREPUNISHMENT) SPEEDS IN CM/SEC
110
100
90
80
70
60
50
40
30
20
10
1 SEC PUNISHED EXTINCTION
1 SEC REGULAR EXTINCTION
16 SEC
PUNISHED EXTINCTION
16 SEC REGULAR EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Figure 3. First segment (prepunishment) running speeds as a function of 1 sec or 16 sec starting area confinement times and regular or punished extinction conditions. The data were compiled according to the prepunishment extinction criterion.

FIGURE 3


FIRST SEGMENT (PREPUNISHMENT) SPEEDS IN CM/SEC
110
100
90
80
70
60
50
40
30
20
10
1 SEC PUNISHED EXTINCTION
1 SEC REGULAR EXTINCTION
16 SEC
REGULAR EXTINCTION
16 SEC
PUNISHED EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

$$N/2 \left\{ \left[(\bar{X}_{D1,\ 1",\ RE} - \bar{X}_{D8,\ 1",\ RE}) - (\bar{X}_{D1,\ 1",\ PE} - \bar{X}_{D8,\ 1",\ PE}) \right] \left[(\bar{X}_{D1,\ 16",\ RE} - \bar{X}_{D8,\ 16",\ RE}) - (\bar{X}_{D1,\ 16",\ PE} - \bar{X}_{D8,\ 16",\ PE}) \right] \right\}^2$$

In the expression above N stands for the number of subjects in each group, $\bar{X}$ stands for a group mean, D indicates the extinction day, 1 or 8, 1" or 16" indicates the group's confinement time, PE indicates punished extinction, and RE indicates regular extinction. The quotient formed by dividing this contrast by the mean-square (within) error for each overall analysis is distributed as an F-ratio with 1 and 448 degrees of freedom. For prepunishment running speeds each test indicated a reliable interaction and thus confirmation of the hypothesis, with both extinction criteria (both F's $\geq$ 7.2, p's $<$ .01).

For further confirmation of the basic hypothesis, each of the three-way interaction contrasts was broken into two-way contrasts, one for the 1-sec groups, and one for the 16-sec groups. Each contrast indicated the amount of slowing down for rats in the punished groups as compared to that for rats in the nonpunished groups, and is shown below.

$$N/2 \left[(\bar{X}_{D1,\ RE} - \bar{X}_{D8,\ RE}) - (\bar{X}_{D1,\ PE} - \bar{X}_{D8,\ PE}) \right]^2$$

These contrasts were divided by the mean square (within) error term for each appropriate overall analysis, the resultant quotient being distributed as an F-statistic with 1 and 448 degrees of freedom. In each case the interaction was reliable for rats in the 1-sec groups (e.g. they demonstrated self-punitive running) but was not reliable for rats in the 16-sec groups (1-sec F's $\geq$ 7.7, p's $<$ .01, both 16-sec F's $\leq$ 2.9, p's $>$ .05).

B. Overall analyses of data compiled with the extinction criterion of one failure to enter the goalbox. Starting scores were subjected to an analysis of variance having as factors extinction day, punishment condition, handling treatment, and startbox confinement time. A summary of this analysis is given in Table 1. As is typical in traditional studies of self-punitive behavior, the only significant source of variance was the main effect of extinction days ($F=21.55$, $p<.01$).

A similar analysis was carried out on prepunishment speed scores (previously shown in Figure 2) revealing significant main effects of startbox confinement time, punishment, and days (F's = 13.30, 5.64, and 45.54, p's $<.01$, $<.05$, and $<.01$, respectively). In addition, the interaction of days with time (shown in Figure 4), handling procedure (Figure 5), and punishment (Figure 6) were all reliable (F's = 2.72, 2.95, and 4.05, respectively, all p's $<.01$). A summary of this analysis is presented in Table 2.

The analysis of postshock running speeds also revealed significant main effects of startbox confinement time, punishment, and days (F's = 6.04, 6.28, and 40.97, p's $<.05$ $<.05$ and $<.01$, respectively). Again punished rats ran faster than nonpunished rats, and those in the 1-sec groups ran faster than those in the 16-sec groups. Also reliable were the three-way interactions of confinement time, handling, and days (shown in Figure 7) and punishment, handling, and days (shown in Figure 8, F's = 2.06, and 2.71, p's $<.05$). The overall summary of these data is presented in Table 3.

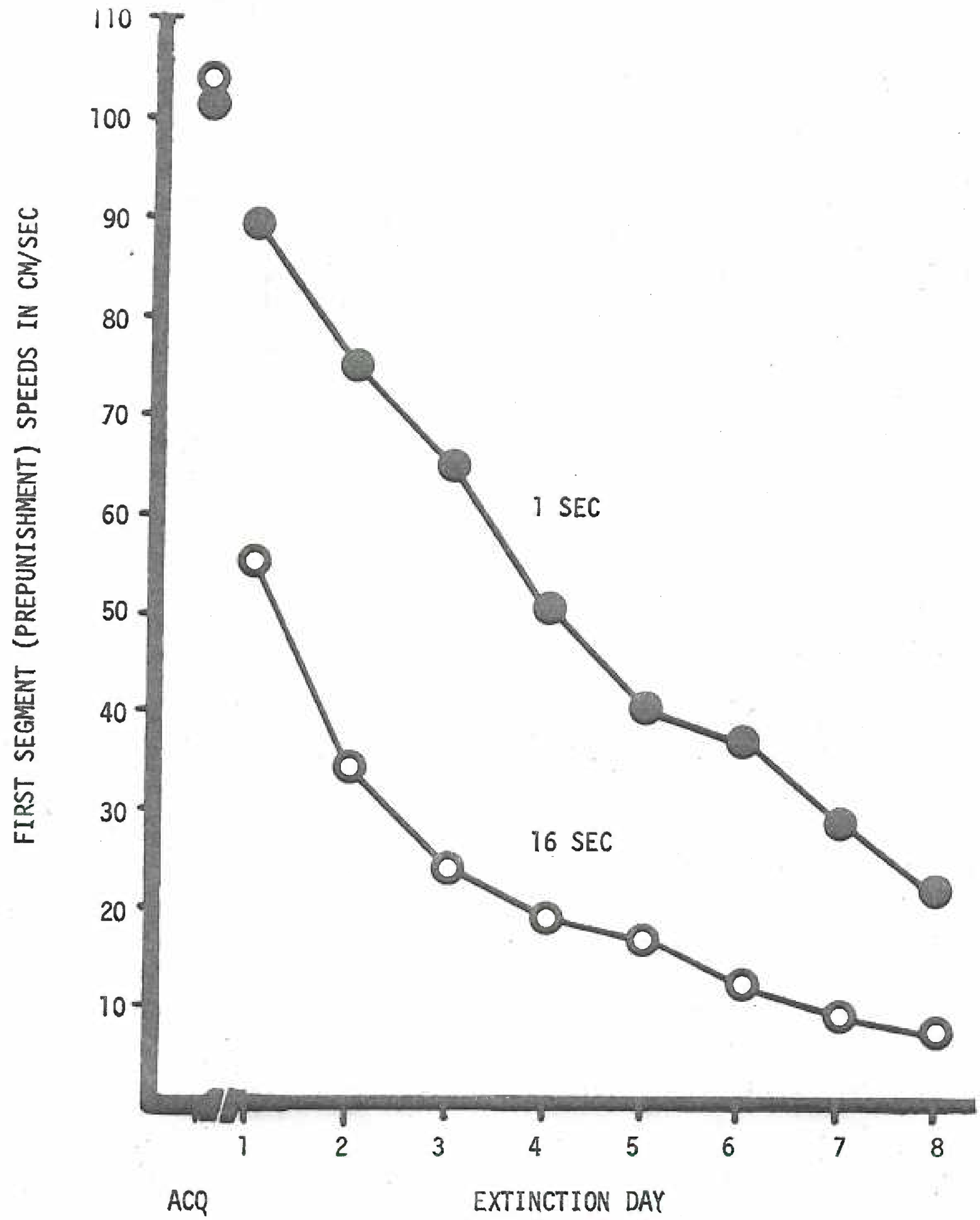
Table 1. Summary of the analysis of variance applied to starting scores. Data compiled according to the goalbox extinction criterion.

Source*	df	ms	F	p
T	1	376.5218	2.12	
H	1	498.9637	2.81	
P	1	120.7253		
D	7	506.2446	21,55	<.01
TH	1	8.5308		
TP	1	116.3697		
HP	1	.1565		
TD	7	8.5485		
HD	7	162.2832		
PD	7	16.2853		
THP	1	72.8899		
THD	7	9.0259		
TDP	7	5.9001		
HPD	7	33.7402	1.44	
THPD	7	12.4999		
error				
between	64	177.6778		
within	448	23.4944		

*T - Starting area confinement time
H - Handling procedure
P - Punished or regular extinction
D - Extinction days

Figure 4. First segment (prepunishment) running speeds as a function of 1 sec or 16 sec starting area confinement times. The data were compiled according to the goalbox extincton criterion.

FIGURE 4



110
100
90
80
70
60
50
40
30
20
10
FIRST SEGMENT (PREPUNISHMENT) SPEEDS IN CM/SEC
1 SEC
16 SEC
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Figure 5. First segment (prepunishment) running speeds as a function of controlled or modified-conventional handling procedure. The data were compiled according to the goalbox extincton criterion.

FIGURE 5

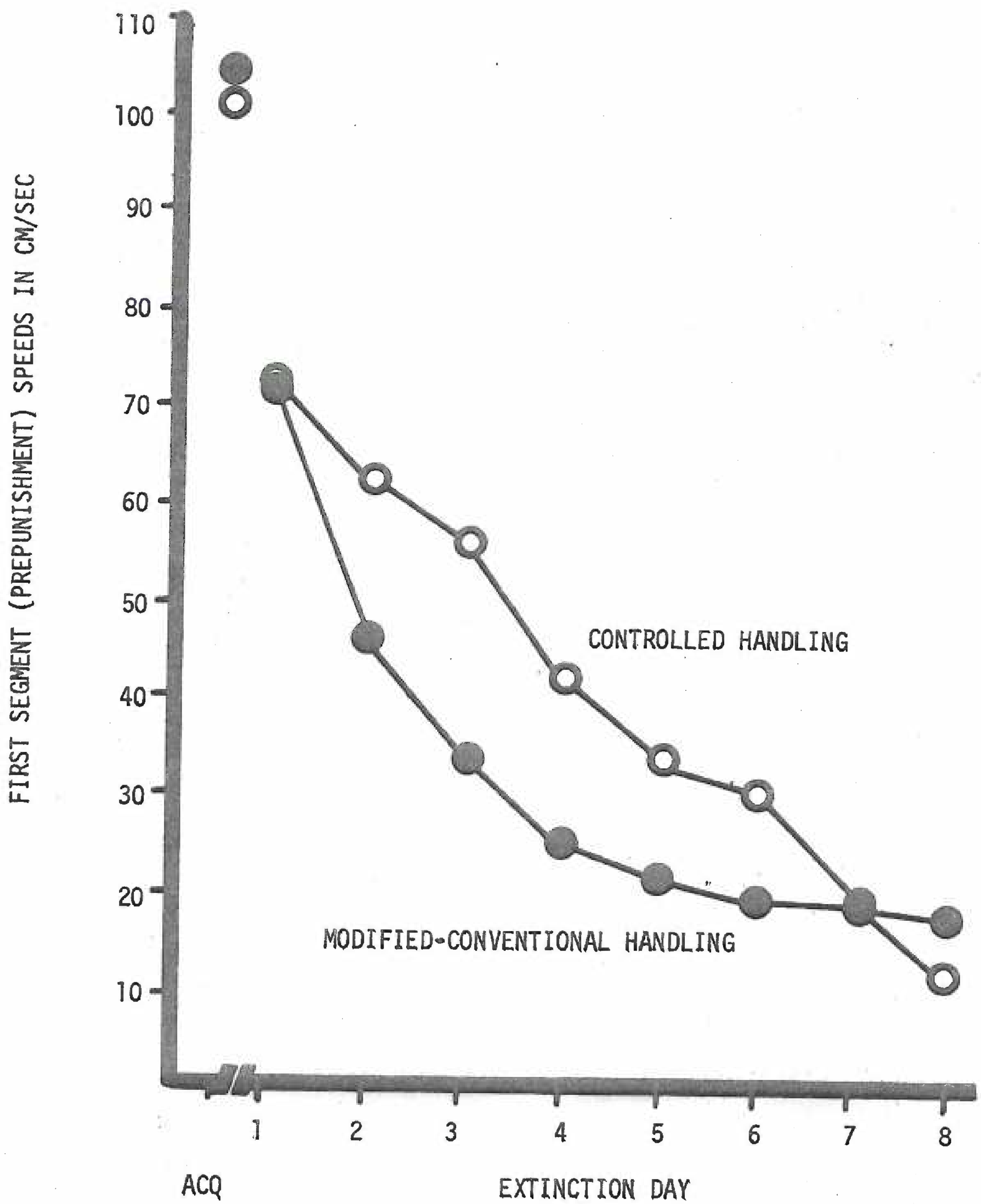

FIRST SEGMENT (PREPUNISHMENT) SPEEDS IN CM/SEC
110
100
90
80
70
60
50
40
30
20
10
CONTROLLED HANDLING
MODIFIED-CONVENTIONAL HANDLING
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Figure 6. First segment (prepunishment) running speeds as a function of punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion.

FIGURE 6

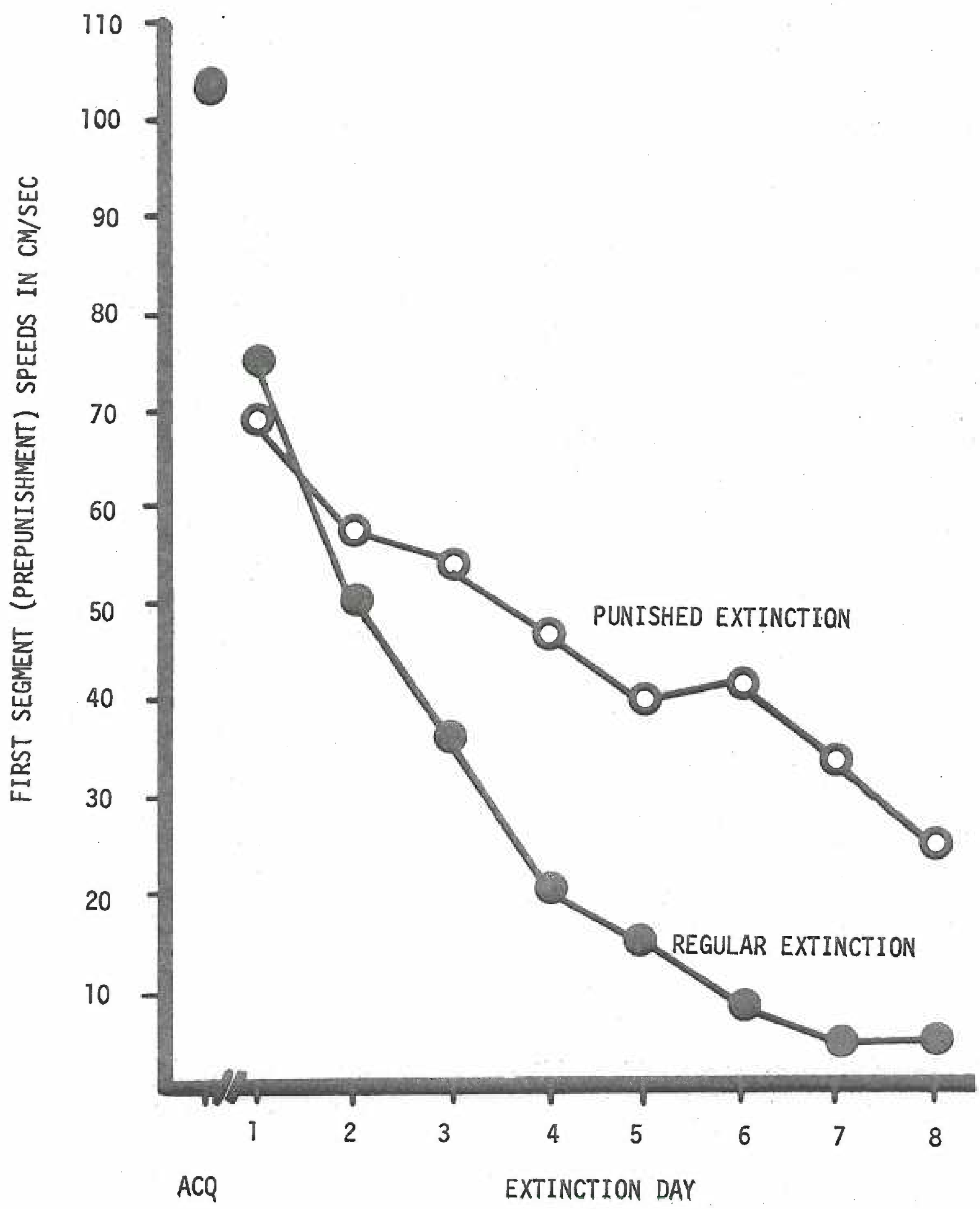

FIRST SEGMENT (PREPUNISHMENT) SPEEDS IN CM/SEC
110
100
90
80
70
60
50
40
30
20
10
PUNISHED EXTINCTION
REGULAR EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Table 2. Summary of the analysis of variance applied to first segment (prepunishment) running speeds. The data were compiled according to the goalbox extinction criterion.

Source*	df	ms	F	p
T	1	115118.8	13.30	< .01
H	1	13177.1	1.52	
P	1	48822.5	5.64	< .05
D	7	27001.7	45.54	< .01
TH	7	4607.0		
TP	1	20034.0	2.31	
HP	1	2554.4		
TD	7	1617.0	2.72	<.01
HD	7	1749.8	2.95	<.01
PD	7	2838.1	4.05	<.01
THP	1	4550.6		
THD	7	271.6		
TDP	7	865.6	1.45	
HPD	7	1022.6	1.72	
THPD	7	228.9		
error				
between	64	8654.2		
within	848	592.9		

*T - Starting area confinement time
H - Handling procedure
P - Punished or regular extinction
D - Extinction days

Figure 7. Third segment (postpunishment) running speeds as a function of 1 sec or 16 sec starting area confinement times and modified-conventional or controlled handling procedure. The data were compiled according to the goalbox extinction criterion.

FIGURE 7

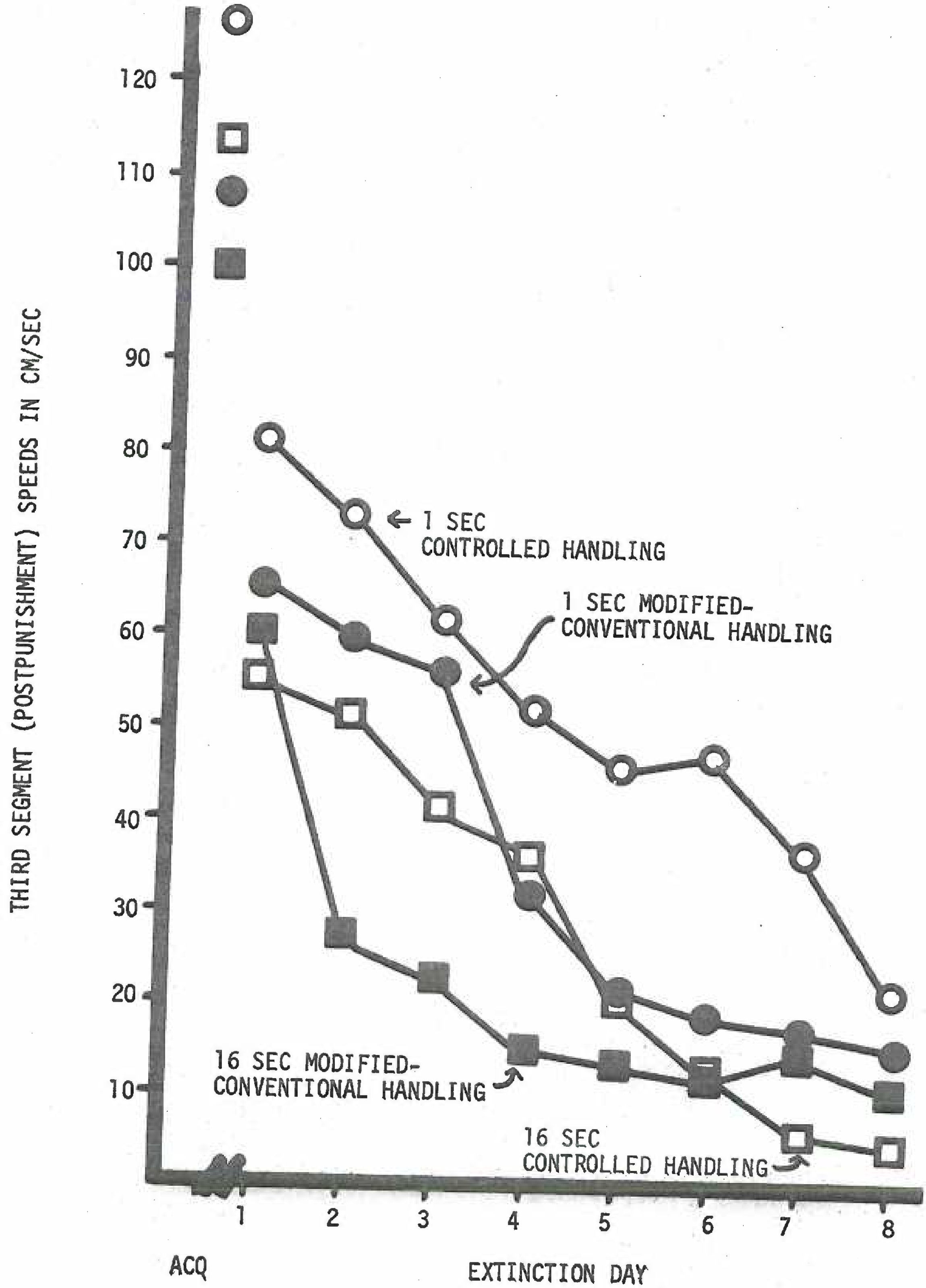

THIRD SEGMENT (POSTPUNISHMENT) SPEEDS IN CM/SEC
120
110
100
90
80
70
60
50
40
30
20
10
1 SEC
CONTROLLED HANDLING
1 SEC MODIFIED-
CONVENTIONAL HANDLING
16 SEC MODIFIED-
CONVENTIONAL HANDLING
16 SEC
CONTROLLED HANDLING
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Figure 8. Third segment (postpunishment) running speeds as a function of controlled or modified-conventional handling procedures and punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion.

FIGURE 8

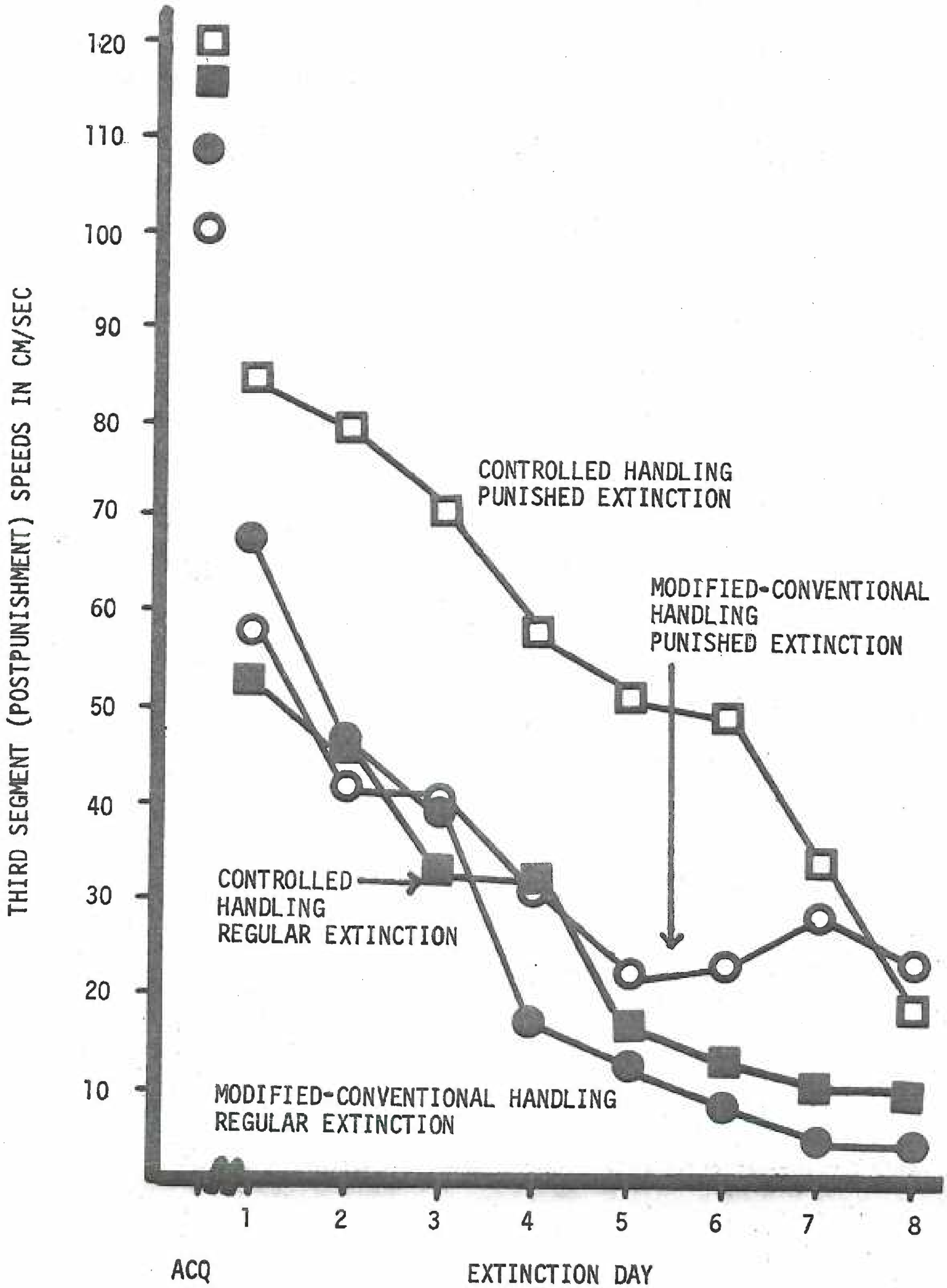

THIRD SEGMENT (POSTPUNISHMENT) SPEEDS IN CM/SEC
120
110
100
90
80
70
60
50
40
30
20
10
CONTROLLED HANDLING
PUNISHED EXTINCTION
MODIFIED-CONVENTIONAL
HANDLING
PUNISHED EXTINCTION
CONTROLLED
HANDLING
REGULAR EXTINCTION
MODIFIED-CONVENTIONAL HANDLING
REGULAR EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Table 3. Summary of the analysis of variance applied to third segment (postpunishment) running speeds. The data were compiled according to the goalbox extinction criterion.

Source*	df	ms	F	P
T	1	50793.8	6.04	< .05
H	1	20270.6	2.41	
P	1	52804.2	6.28	< .05
D	7	23751.1	40.97	< .01
TH	1	3635.0		
TP	1	8625.7	1.03	
HP	1	14975.6	1.78	
TD	7	553.8		
HD	7	951.1	1.64	
PD	7	456.6		
THP	1	12684.3	1.51	
THD	7	1191.8	2.06	< .05
TDP	7	619.8	1.07	
HPD	7	1568.8	2.71	< .05
THPD	7	195.7		
<u>error</u>				
between	64	8412.1		
within	448	579.7		

*T - Starting area confinement time
H - Handling procedure
P - Punished or regular extinction
D - Extinction days

C. Overall analyses of data compiled according to the extinction criterion of one failure to leave the prepunishment zone.

As expected, the analyses conducted according to the prepunishment extinction criterion were not completely parallel to those with the goalbox extinction criterion. The visually evident superiority of nonpunished over punished subjects in the starting area (see Figure 9) was supported by the statistical analysis of starting areas. Reliable main effects of days and punishment were observed ($F = 7.68$, $p < .01$ and $F = 6.82$, $p < .01$), as well as a two-way interaction between punishment and days ($F = 3.83$, $p < .01$) and a three-way interaction between days, handling, and punishment ($F = 3.36$, $p < .01$). The analysis is summarized in Table 4.

The analysis of prepunishment speeds (plotted in Figures 3 and 10) indicated relationships that were considerably more consistent with those obtained with the traditional extinction criterion than were startbox results. As in the case of the traditional criterion, the main effects of confinement time and days proved reliable (although punishment did not) with F-values of 11.49 and 33.59, p's $< .01$. Also parallel with the traditional analysis, the interaction of days with confinement time, handling procedure, and punishment were all reliable (F's = 3.15, 2.13, and 2.13, $p < .01$, $p < .05$, and $p < .05$, respectively). In addition, the three-way interaction of handling, punishment, and days proved significant with an F-value of 3.02 and a $p < .01$. The analysis is summarized in Table 5.

Figure 9. Starting scores as a function of modified-conventional or controlled handling procedure and punished or regular extinction conditions. The data were compiled according to the prepunishment extinction criterion.

FIGURE 9

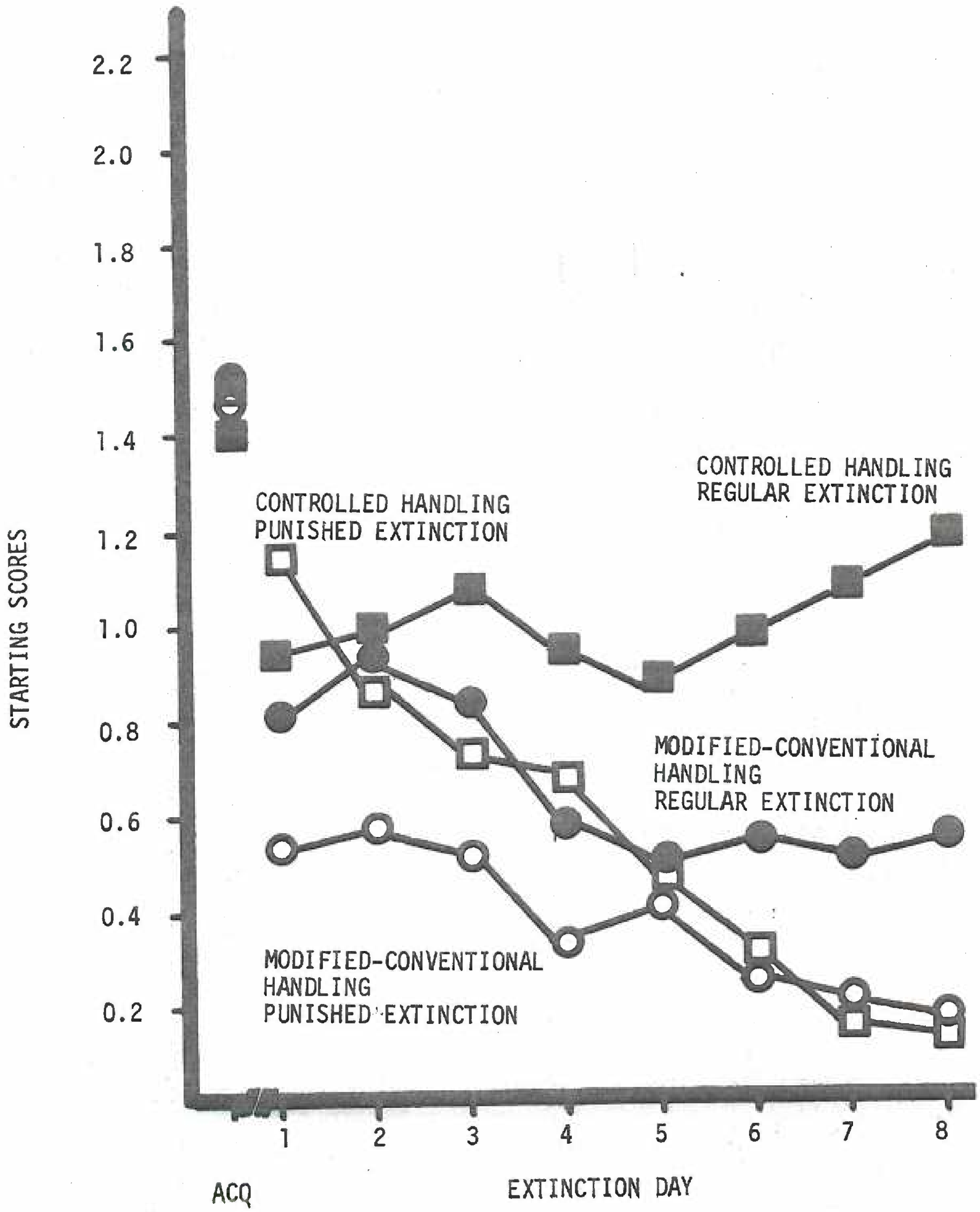

STARTING SCORES
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
CONTROLLED HANDLING
REGULAR EXTINCTION
CONTROLLED HANDLING
PUNISHED EXTINCTION
MODIFIED-CONVENTIONAL
HANDLING
REGULAR EXTINCTION
MODIFIED-CONVENTIONAL
HANDLING
PUNISHED EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Table 4. A summary of the analysis of variance applied to starting scores. The data were compiled according to the prepunishment extinction criterion.

Source*	df	ms	F	P
T	1	226.6		
H	1	1008.3	3.58	
P	1	1918.0	6.82	<.05
D	7	170.8	7.68	<.01
TH	1	10.2		
TP	1	240.6		
HP	1	101.7		
TD	7	6.9		
HD	7	8.1		
PD	7	85.6	3.83	<.01
THP	1	87.9		
THD	7	21.7		
TDP	7	19.5		
HPD	7	74.6	3.36	<.01
THPD	7	14.9		
error				
between	64	281.3		
within	448	22.2		

*T - Starting area confinement time
H - Handling procedure
P - Punished or regular extinction
D - Extinction days

Figure 10. First segment (prepunishment) running speeds as a function of modified-conventional or controlled handling procedure and punished or regular extinction conditions. The data were compiled according to the prepunishment extinction criterion.

FIGURE 10

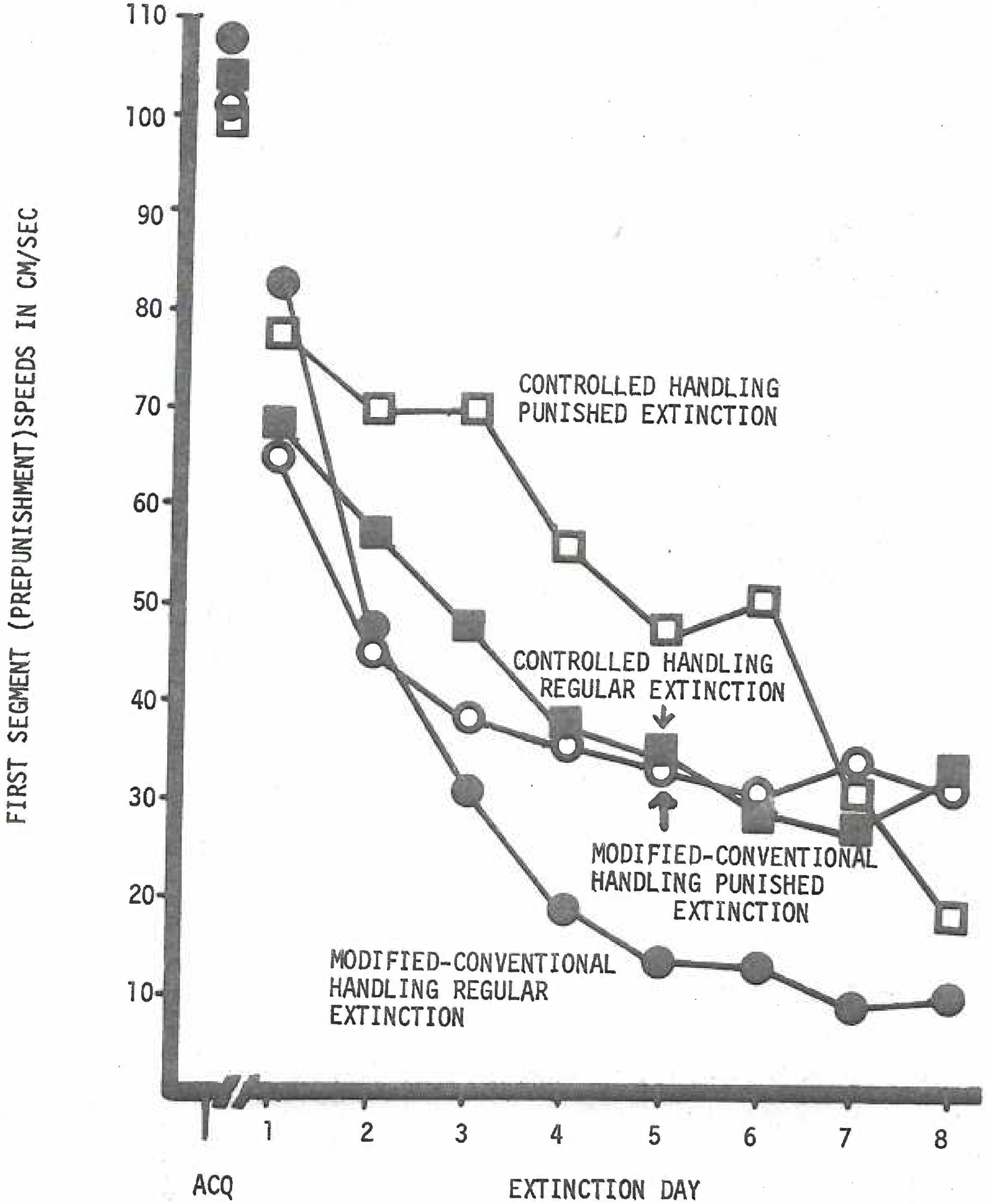

110
100
90
80
70
60
50
40
30
20
10
FIRST SEGMENT (PREPUNISHMENT)SPEEDS IN CM/SEC
CONTROLLED HANDLING PUNISHED EXTINCTION
CONTROLLED HANDLING REGULAR EXTINCTION
MODIFIED-CONVENTIONAL HANDLING PUNISHED EXTINCTION
MODIFIED-CONVENTIONAL HANDLING REGULAR EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Table 5 A summary of the analysis of variance applied to the first segment (prepunishment) running speeds. The data were compiled according to the goalbox extinction criterion.

Source*	df	ms	F	P
T	1	101415.7	11.49	$< .01$
H	1	25988.1	2.94	
P	1	17106.4	1.93	
D	7	20674.4	33.59	$< .01$
TH	1	1954.3		
TP	1	25800.3	2.92	
HP	1	5.2		
TD	7	1943.6	3.15	$< .01$
HD	7	1309.9	2.13	$< .05$
PD	7	1311.7	2.13	$< .05$
THP	1	8594.8		
THD	7	412.7		
TDP	7	1069.4	1.74	
HPD	7	1861.0	3.02	$< .01$
THPD	7	180.5		
<u>error</u>				
between	64	8825.7		
within	448	615.4		

*T - Starting area confinement time
H - Handling procedure
P - Punished or regular extinction
D - Extinction days

D. Trials to extinction. The number of trials each rat required to reach each of the extinction criteria was calculated for each rat in each group. Rats which met an extinction criterion were assigned a score corresponding to the number of trials required to reach that criterion, including the trial on which it was met. Animals that did not extinguish were assigned a score of 33, one greater than the number of trials completed. Mean scores for each group and each extinction criterion are shown in Table 6.

1. A priori statistical tests. Statistical comparisons of punished and nonpunished rats in each of the two confinement groups were conducted for the data of each extinction criterion. Punished and nonpunished rats in the 1-sec groups did not differ in terms of trials to extinction by either extinction criterion (F's $>$ 1.15). Punished rats in the 16-sec confinement groups, however, required significantly fewer trials than their nonpunished counterparts to reach the prepunishment criterion ($F = 14.11$, $p < .01$) but not to reach the goalbox criterion ($F = 1.98$).

2. Overall analyses. Following the a priori tests overall analyses of the data were conducted. The only reliable source of variance with the goalbox criterion was the main effect of startbox confinement time ($F = 6.23$, $p < .025$). Both an overall suppressive effect due to punishment ($F = 11.67$, $p < .01$) and a reliable effect of handling procedure ($F = 8.78$, $p < .01$) were revealed by analysis of data from the prepunishment extinction criterion. The punishment-by-confinement-time interaction approached reliability ($F = 3.62$, $p = .062$).

Table 6 Mean trials to extinction as a function of extinction treatment and extinction criterion.

One failure to enter the goalbox

1-sec

	Modified Conventional	Controlled Handling
Regular Extinction	14.1	18.5
Punished Extinction	15.7	22.4

16-sec

	Modified Conventional	Controlled Handling
Regular Extinction	12.9	15.2
Punished Extinction	7.9	11.2

One failure to leave the prepunishment zone

1-sec

	Modified Conventional	Controlled Handling
Regular Extinction	19.5	22.7
Punished Extinction	16.2	23.2

16-sec

	Modified Conventional	Controlled Handling
Regular Extinction	17.8	29.7
Punished Extinction	8.3	11.8

Discussion

In considering the results of this experiment it seems appropriate to turn first to those which proved most reliable, regardless of the extinction criterion. One such effect, the interaction of punishment and extinction days, was statistically significant for first segment speeds. With both criteria, the presence of punishment in the middle of the alley served to maintain vigorous high-speed locomotor behavior in the prepunishment segment. Overall then, self-punitive behavior was demonstrated in this experiment. The highly reliable three-way interaction shown by the a priori tests, however, indicated that the extent to which punishment served to maintain high speed running was a function of the duration of startbox confinement. Punished subjects in the 1-sec groups ran significantly faster than their nonpunished counterparts while those in the 16-sec groups did not. Thus, it would seem that several important facts have been established. First, self-punitive behavior can be readily demonstrated in a straight alley with a guillotine-door starting procedure. Delude's notion, that observations of self-punitive behavior are limited to studies where either drop-starting procedures are used or some non-neutral CSs are employed, therefore, is probably unwarranted. Second, the demonstration of self-punitive behavior was not dependent on the use of the traditional extinction criterion of one failure to enter the goalbox. With such an extinction criterion (one failure to leave the prepunishment zone), however, self-punitive behavior was also observed. This outcome, then, would render less likely the possibility that the failures of Delude (1973, 1974) and of Delprato and Meltzer (1974) to demonstrate sustained high-speed running for punished subjects extinguished with the guillotine-door procedure can be attributed exclusively to their use of a prepunishment extinction criterion. Finally, the demonstration of self-punitive running was dependent upon short starting-area exposures prior to each trial. The self-punitive phenomenon was observed with the 1-sec but not with the 16-sec confinement interval. It may be, therefore, that both Delude's and Delprato and Meltzer's failure to demonstrate self-punitive running for rats in their guillotine-door groups was due not to their use of guillotine door itself but rather to a less-than-optimal confinement time.

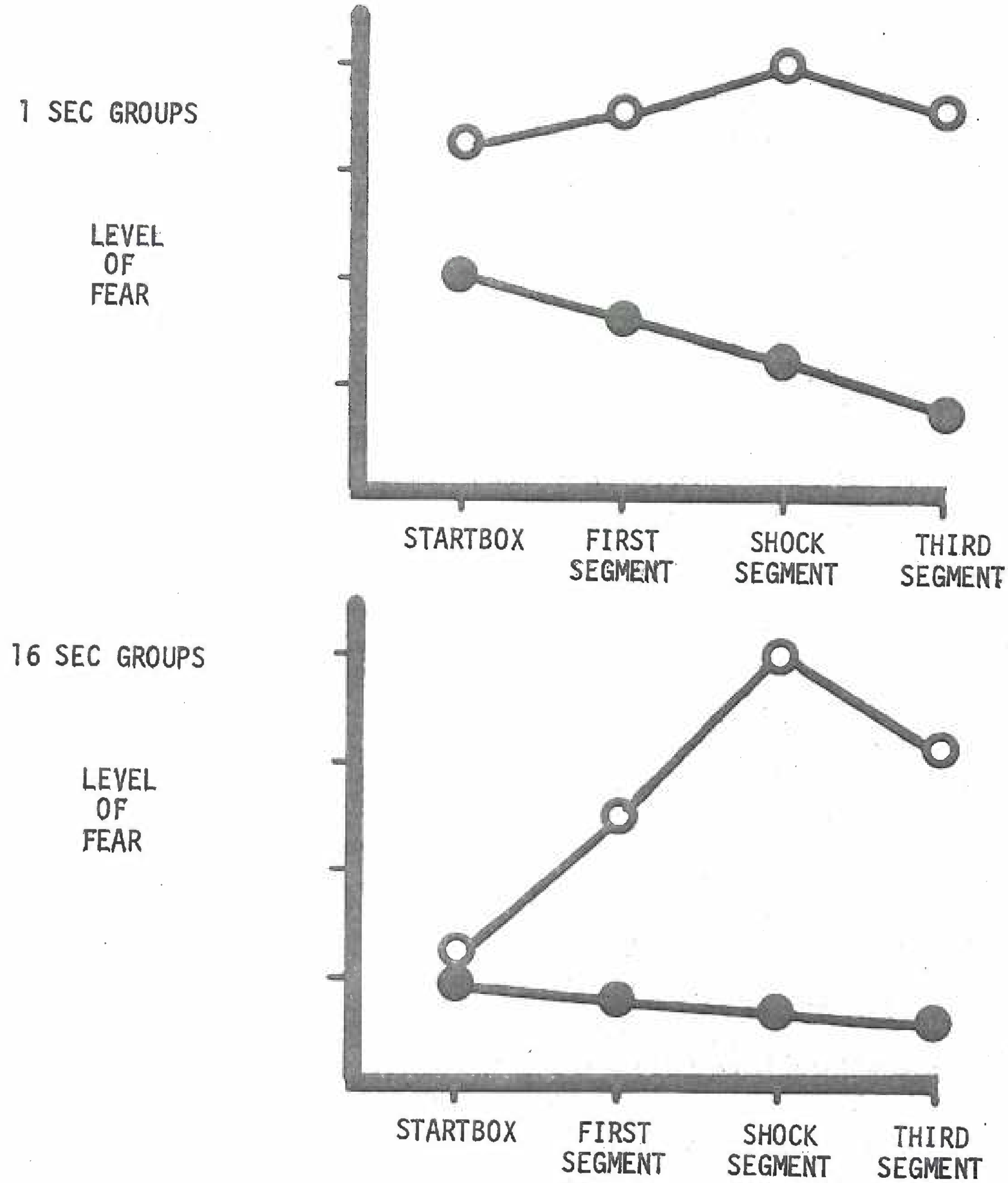
These results would seem to agree well with a conditioned fear interpretation of self-punitive behavior, an associative interpretation, or a cognitive discrimination hypothesis. Predictions based on the conditioned-fear hypothesis would rely on the fact that long confinements would produce greater extinction of fear than shorter confinements. Thus, for rats in the long-confinement groups the cues of the starting area and the similar cues of the prepunishment segment would elicit less fear to be escaped and/or to motivate forward locomotor tendencies elicited by these cues. One would expect, therefore, both poorer punished- and regular-extinction performance for rats in the 16-sec confinement groups than for those in the 1-sec groups.

For punished rats in both the 1-sec and 16-sec groups fear would be reconditioned to middle segment cues on each trial, and generalize to the starting area and prepunishment segment. The differential exposure to starting area cues, however, would be expected to extinguish the fear elicited by those cues, and the similar prepunishment segment cues, much more for rats in the 16-sec groups than the 1-sec groups. The outcome of these processes, assuming equal fear conditioned to shock zone cues for both 1-sec and 16-sec rats, might be as shown in the hypothetical gradients drawn in Figure 11. Generalized fear elicited by starting area and prepunishment cues for punished subjects in the 1-sec groups would be nearly as great as that elicited in the shock zone. Because no fear is reconditioned to shock zone cues for non-punished rats, none can generalize to starting area or prepunishment cues. The hypothetical fear gradient for punished subjects in the 1-sec groups would be relatively flat, and at all points higher than that of nonpunished subjects. For punished subjects in the 16-sec group the gradient would again be higher, overall, for punished than non-punished rats. For punished subjects, however, any forward locomotion out of the starting area would be accompanied by substantially increased fear, and the subjects, therefore, would be expected to cease running.

This fear gradient conception, put forth by Melvin (1971) and expanded and given additional empirical support by Eaton (1972) can also address the frequently noted observation that punished subjects, in general, typically extinguish by failing to leave the prepunishment zone, while nonpunished subjects typically extinguish by failing to enter the goalbox (Delude, 1969). Over trials, punished subjects are given more and more exposures to startbox cues which are not immediately followed by, or concurrent with, shock onset. Punishment segment and shock zone cues, however, are either coincident with, or more immediately followed by shock onset. Thus, punished extinction with fixed shock-zone location is like a differential conditioning paradigm. The hypothetical fear gradient, therefore, should become increasingly steeper over trials

Figure 11. Hypothetical fear gradients during punished or regular extinction for subjects with 1 sec and 16 sec starting area confinement times.

FIGURE 11


1 SEC GROUPS
LEVEL OF FEAR
STARTBOX
FIRST SEGMENT
SHOCK SEGMENT
THIRD SEGMENT
16 SEC GROUPS
LEVEL OF FEAR
STARTBOX
FIRST SEGMENT
SHOCK SEGMENT
THIRD SEGMENT

until, eventually, punished subjects no longer flee from the then benign startbox cues.

An associative interpretation (Crowell, Brown, & Lewis, 1972) would rely on mechanisms quite similar to those of the conditioned-fear interpretation but, as its name implies, is cast in purely associative terms rather than motivational-associative terms. During acquisition training the cues of the starting area and alley acquire the capability of eliciting forward locomotor tendencies. During extinction, to the extent that punished extinction is more like acquisition than regular extinction (the stimulus-similarity concept) and/or the running response is reinforced as each punished animal runs off the shock zone, punished subjects will perform better than nonpunished subjects. Long starting-area confinement, in the presence of cues that elicit forward locomotor responding but where such responses are thwarted, however, would lead to the extinction of such responding. Rats in the 16-sec groups, therefore, would be expected to demonstrate poorer extinction performance than those in the 1-sec groups. Finally, some minimal level of response strength may be required for punished subjects to run forward onto the punishment zone so that their forward responding is reinforced by shock offset as they leave that segment. This threshold may not be reached by subjects in the 16-sec groups, but may be surpassed by those in the 1-sec groups, thus leading to self-punitive running for those in the latter groups, but not the former.

A cognitive discrimination hypothesis, such as championed by Dreyer and Renner (1971) or Renner and Tinsley (1975) would lead one to the same predictions, but based on different conceptions of self-punitive behavior. Long startbox confinement might be predicted to retard extinction performance because it would give the rats more opportunity to learn that shock is no longer present in the startbox. Thus, they need not flee when the door is opened. Punished rats in the long confinement groups would, therefore, be less likely to experience shock in the middle alley segment and become confused about the presence and/or location of shock in the alley. They might also have ample opportunity to learn that running responses are punished but that no shock occurs if they do not run. Punished rats in the short confinement groups, however, would not only have less opportunity to learn that no shock was present in the goalbox, but could also become confused about the location of shock in the alley or the contingency between running and shock. Thus, they might "mistakenly" run self-punitively for many trials.

Punishment in the second segment was also a significant source of variance in the data of the third segment, reliably increasing postshock-segment running speeds for punished subjects. It could be that the failure to observe the three-way interaction of punishment, confinement time, and handling, was due to the presence of shock in the second segment for punished subjects. Contributions to postshock running speed, either from postshock increments to drive level, or carried over from high-speed running on the charged grid, could have "washed-out" differences between 1-sec and 16-sec punished subjects requisite for a reliable three-way interaction. It is not clear, however, were the above the case, why reliable three-way interactions were obtained among handling, confinement time, and days, on the one hand, and handling, punishment, and days, on the other. The first interaction could be attributed to the combined motivational influences of greater contributions to drive of short than long confinements, and greater contributions to drive for subjects handled with the controlled handling procedure than the modified-conventional procedure. Highest drive for those in the short-confinement, controlled-handling group, moderate drive levels for those in the short-confinement conventional-handling group and the long-confinement controlled-handling group, and low drive for those in the long-confinement conventional-handling group, combined with a floor-effect, could have led to the observed interaction. In the same way, the greater drive-arousing properties of shock in the middle segment, combined with differential contributions to drive from the two handling procedures, could have produced the observed interaction of handling, punishment, and days.

Rather than a facilitative effect of punishment on starting scores, a suppressive effect was observed with data based on the prepunishment extinction criterion, but no effect was obtained from data based on the goalbox extinction criterion. It is not clear at this point to what degree one should rely on these contradictory results. Perhaps freezing at the beginning of a trial could be an initial unconditioned response to a highly fear-arousing environment. Further speculation on this point, however, would not seem warranted given the conflicting results of the two analyses. Finally, the effects of handling procedure on starting scores would seem attributable, in this case as in the others, to greater drive arousing properties of the controlled than modified-conventional handling procedures.

In summary, self-punitive running was demonstrated in this experiment by rats in the short- but not by those in the long-confinement groups. This outcome could be explained by either a conditioned-fear, an associative, or a cognitive discrimination interpretation. The handling procedures did appear to have an effect. Rats run with the controlled handling procedure performed better than those with the modified-conventional procedure, perhaps because of the closer contiguity between handling and the beginning of a trial for rats in the former groups than in the latter. Handling procedure, however, was not a factor affecting either the display of self-punitive running by rats in the short confinement groups or the failure to exhibit self-punitive behavior by these in the long confinement groups.

EXPERIMENT 2

Introduction

The second experiment was designed to address more directly the specific problem posed by the demonstrations of Delude (1973) and Delprato and Meltzer (1974), that rats extinguished with the drop-start procedure ran faster, overall, and showed greater punishment-produced facilitation, than rats extinguished with the guillotine-door starting procedure. It may be recalled that Delude (1973) suggested that the difference between the performance of rats run with these two procedures was a function of innate fear produced by the drop from the upper to lower startbox compartments for rats with the drop-start procedure. Delude contrasted this alternative to the conditioned-fear interpretation. In his 1974 paper he stated "if the running behavior is totally explicable in terms of fear classically conditioned to startbox cues, it should make little difference how the animal gets into the startbox." While we might agree that how an animal gets into the startbox before the beginning of a trial may not be of primary importance, it does seem that what occurs after the animal enters the startbox, but before it is allowed to leave, is critical. Rats run with the drop-start procedure typically are not held in the lower startbox once dropped into it, but are permitted to enter the alley immediately. Those run with the guillotine-door starting procedure, on the other hand, are commonly held in the lower startbox for some period of time prior to the beginning of each trial. From a conditioned-fear interpretation of self-punitive behavior, therefore, one might expect that rats run with the drop-start procedure would demonstrate better performance than those run with the guillotine-door starting procedure. Appeal could be made to either greater extinction of fear and of locomotor responses for rats with the guillotine-door starting procedure, or to better (shorter) CS-US intervals for the conditioning of fear and running, for rats with the drop-start procedure.

If confinement time with lower startbox were held constant, rats run with the guillotine-door procedure might perform similarly to those run with the drop-start procedure; both the time during which extinction could occur and the CS-US interval would be constant for both groups. Any differences in performance might be attributable to possible differences in the saliency of the cues as between the drop-start and the guillotine-door procedure. However, if rats were extinguished with the guillotine-door procedure and a long startbox confinement, they should perform more poorly than rats with the drop-start procedure and a short confinement time. Conversely, rats extinguished with the guillotine-door procedure and a short confinement time should perform better than rats extinguished with the drop-start procedure and a long confinement time.

The following experiment was designed to test these notions. A 2 x 2 x 2 x days design was followed. The first factor was regular vs. punished extinction, the second was drop vs. guillotine-door starting procedure, and the third was lower startbox confinement time (1 vs. 16 sec). As in the first experiment, the data were compiled according to both the traditional goalbox extinction criterion and the newer prepunishment criterion.

Method

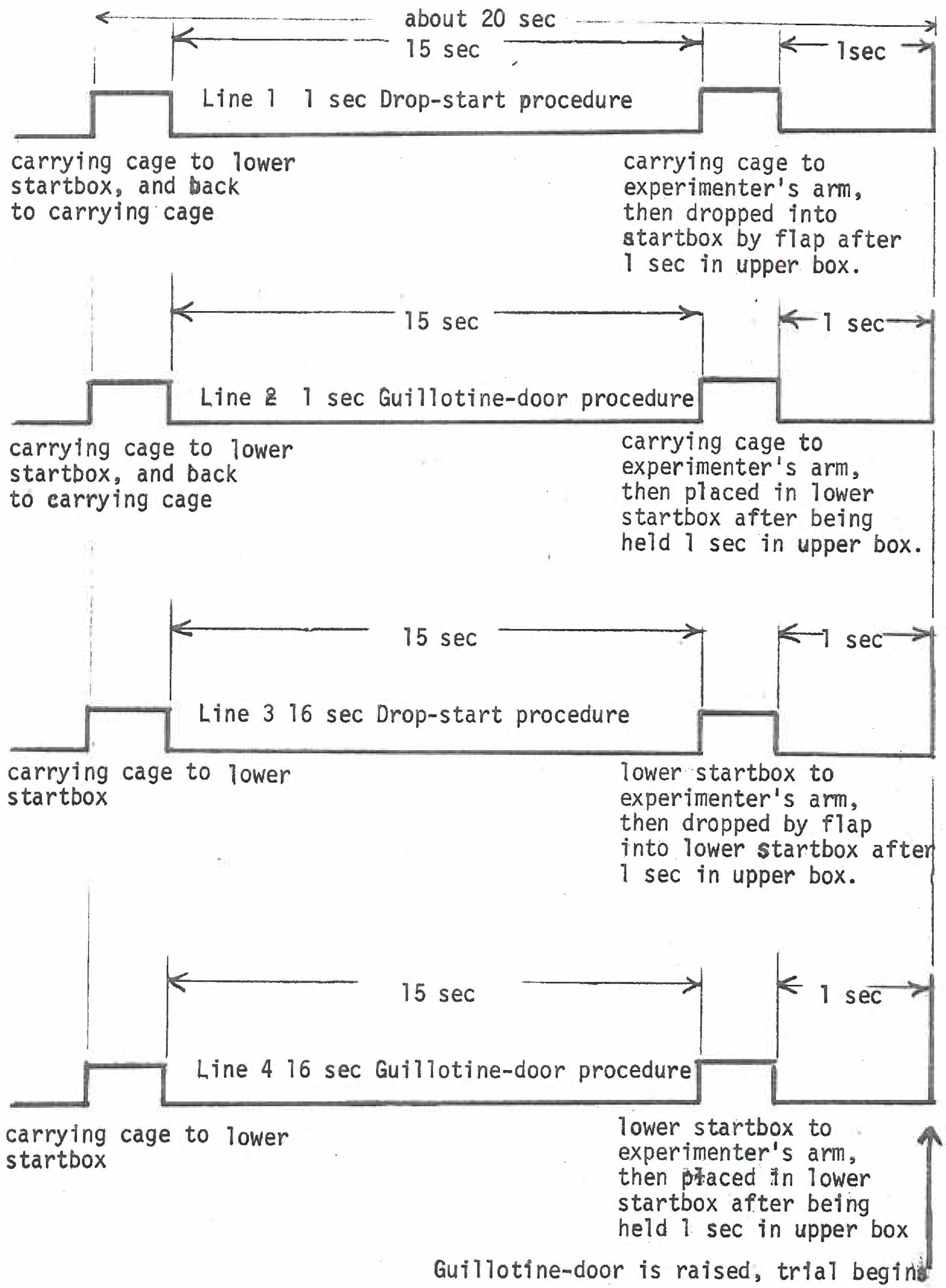
Subjects. The subjects were 88 naive female albino rats (Sprague-Dawley derivatives from Charles River, Inc., Wilmington, Mass). They were 65-75 days old at the beginning of the experiment and weighed between 170 gm and 222 gm. They were individually housed and maintained on an *ad lib* food and water regimen.

Procedure. The general procedure, as in the first experiment, consisted of shock-escape training followed by regular or punished extinction. Extinction trials were given with one of the four possible combinations of short (1-sec) or long (16-sec) starting area confinement time and either drop-start or guillotine-door start procedure. Each trial began when the startbox guillotine-door was raised, allowing the rat to traverse the alley, and terminated when a second guillotine-door was lowered after the rat had entered the goalbox. Following confinement in the goalbox for 25-30 sec the rats were returned to their carrying cage. Four trials were administered daily with an intertrial-interval of 40-55 min. For animals in the punished extinction groups 50 v shock was present only in the middle 61-cm alley segment. No shock was present anywhere in the alley for those in the nonpunished groups.

On Day 1 of the experiment each rat was handled, weighed, and marked as in Experiment 1. On Days 2-7 an acquisition regimen like that used in the first experiment was followed. Three shaping days, in which progressively longer segments of alley and increasing shock intensities were utilized, preceded three days of full-alley shock-escape training with 50-v shock. A different combination of starting procedure and confinement time was used, in randomly determined order, on each of the four daily acquisition trials. Figure 12 diagrams the four treatments. Rats with all treatments were taken from their carrying cages about 20 sec prior to each trial. They were gently held in the upper compartment of the bi-level starting chamber for 1 sec and then placed on the starting area grid floor. Those with 16-sec confinements (Lines 3 and 4) remained there for 15 sec while those with the 1-sec confinements (Lines 1 and 2) were immediately returned to their carrying cages where they remained for 15 sec. After the 15 sec had elapsed, rats in all groups were picked up and placed on the experimenter's arm. Those with the drop-start treatment (Lines 1 and 3) were then placed on the trapdoor floor of the upper holding compartment. After 1 sec the floor was released, and they dropped to the starting area below where they remained 1 sec, until the guillotine-door was raised. Rats in the guillotine-door groups (Lines 2 and 4) were taken from the experimenter's arm, and gently held 1 sec in the upper holding area. They were then lowered to the grid where they remained 1 sec until the guillotine-door was raised and the trial began. Thus, with both starting procedures the rats were handled the same number of times, at about the same interval before each trial, and were exposed to upper holding area stimuli for the same length of time. They differed in that the drop-start rats were dropped into the starting area while guillotine-door rats were manually placed in the lower starting area, and the short confinement rats were given only brief exposure to startbox cues before each trial while those in the long confinement groups were exposed for a substantially longer time.

Figure 12. A diagram of the four combinations of drop or guillotine-door starting procedure and 1 sec or 16 sec starting area confinement times given subjects during acquisition and extinction.

FIGURE 12


about 20 sec
15 sec
1sec
Line 1 1 sec Drop-start procedure
carrying cage to lower startbox, and back to carrying cage
carrying cage to experimenter's arm, then dropped into startbox by flap after 1 sec in upper box.
15 sec
1 sec
Line 2 1 sec Guillotine-door procedure
carrying cage to lower startbox, and back to carrying cage
carrying cage to experimenter's arm, then placed in lower startbox after being held 1 sec in upper box.
15 sec
1 sec
Line 3 16 sec Drop-start procedure
carrying cage to lower startbox
lower startbox to experimenter's arm, then dropped by flap into lower startbox after 1 sec in upper box.
15 sec
1 sec
Line 4 16 sec Guillotine-door procedure
carrying cage to lower startbox
lower startbox to experimenter's arm, then placed in lower startbox after being held 1 sec in upper box
Guillotine-door is raised, trial begins

As in Experiment 1, following Day 7, the rats were randomly assigned to one of the eight groups. One group in each of the punished or regular extinction conditions was given all extinction trials using one of the four combinations of startbox confinement time and starting procedure. Extinction trials continued, four per day, until each rat met each extinction criterion or completed eight extinction days.

The experiment was conducted in two replications of 44 rats each. Of these 88 rats, 2 were injured and discarded, 3 did not receive the extinction treatment and were discarded, and 3 were randomly eliminated. The remainder, 10 in each of the 8 groups, received the extinction treatment. Their performance is analyzed and discussed in the following sections. There were no "posturers," rats with mean startbox latencies greater than 5 sec, in this experiment.

Results

Escape acquisition. Mean starting scores, first 61-cm segment speeds, and third 61-cm segment speeds were calculated for each rat for the last day of acquisition and subjected to analyses of variance with the extinction pseudofactors as in the first experiment. The results indicated neither reliable main effects nor interactions for starting scores or running speeds. Thus, no extinction differences could be attributed to performance differences at the end of acquisition.

Extinction. Mean starting scores, and preshock (first segment) and postshock (third segment) speeds were compiled with the goalbox and prepunishment extinction criteria following the procedure established in the first experiment. Again, subjects were assigned the minimum starting score of .07 and running speeds of 4.1 cm/sec on the trial on which they extinguished, and each trial thereafter.

A. A priori statistical tests. One of the basic questions asked in this experiment was whether, with time in the starting area equated, rats run with the drop-start procedure would demonstrate better self-punitive behavior than rats in the guillotine-door groups. Empirically, the question could be stated "With confinement time equated, is the difference in slowing down over extinction trials, between punished and nonpunished subjects, greater for those with the drop than the guillotine-door procedure?" Figures 13, 14, 15, and 16 show the performance of the 1-sec and 16-sec groups with the goal box criterion and the prepunishment criterion. As can be seen, no marked differences are evident in the responses to punishment of subjects run with the two procedures. Three-way contrasts, identical in form to those in the first experiment, were used to provide a direct statistical answer to the question. Each of the four F-ratios supported the visual impression that the interactions were not reliable (all F's ≤ 2.23, p's $\geq .136$, df 1, 504).

B. Overall analyses of data compiled with the extinction criterion of one failure to enter the goalbox. Starting scores were subjected to an analysis of variance having as factors extinction day, punishment, starting procedure, and confinement time. A summary of the analysis is given in Table 7. As with the first experiment, the days factor was highly reliable as a source of variance ($F = 20.81$, $p < .01$). As can be seen from Figure 17, however, the punished subjects performed better over days, extinguishing more slowly, than nonpunished subjects ($F = 2.56$, $p < .05$). The superior performance, over days, of the dropped rats over guillotine-door rats (shown in Figure 18) was also statistically reliable ($F = 2.28$, $p < .05$) as was the three-way

Figure 13. First segment (prepunishment) running speeds of subjects in the 1 sec confinement groups as a function of drop or guillotine-door starting procedure and punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion.

FIGURE 13

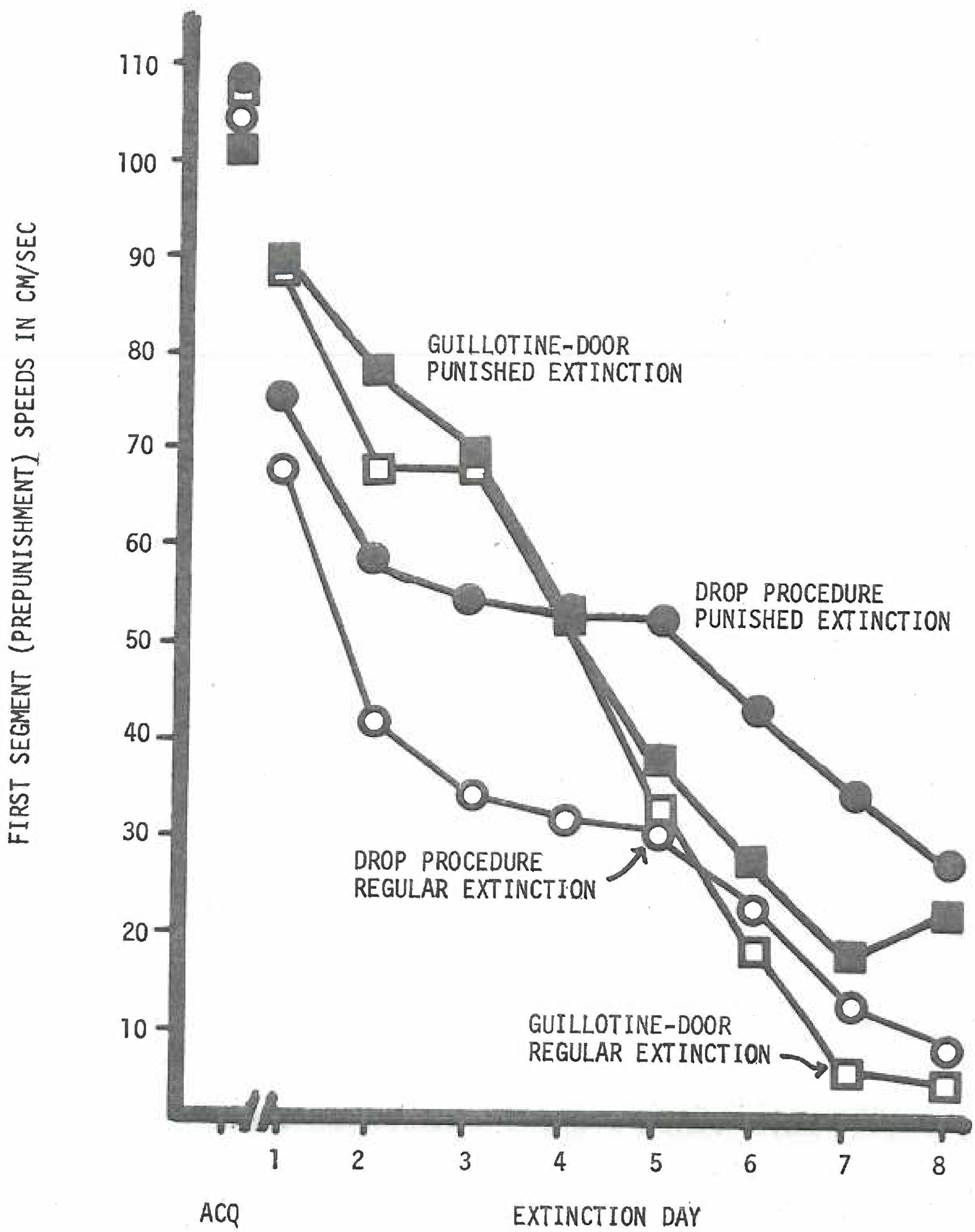

FIRST SEGMENT (PREPUNISHMENT) SPEEDS IN CM/SEC
110
100
90
80
70
60
50
40
30
20
10
GUILLOTINE-DOOR
PUNISHED EXTINCTION
DROP PROCEDURE
PUNISHED EXTINCTION
DROP PROCEDURE
REGULAR EXTINCTION
GUILLOTINE-DOOR
REGULAR EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Figure 14. First segment (prepunishment) running speeds of subjects in the 1 sec confinement groups as a function of drop or guillotine-door starting procedure and punished or regular extinction conditions. The data were compiled according to the prepunishment extinction criterion.

FIGURE 14

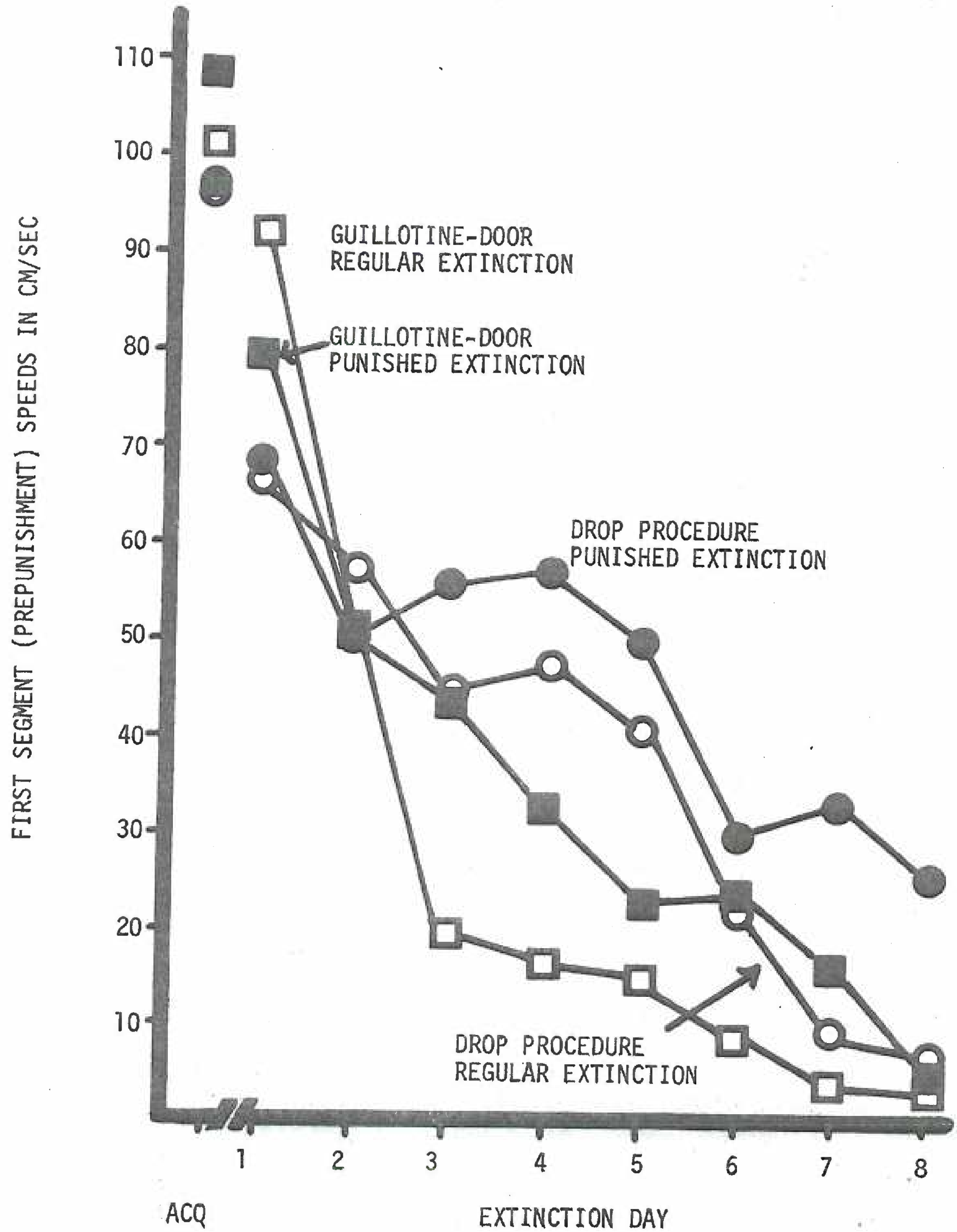

110
100
90
80
70
60
50
40
30
20
10
FIRST SEGMENT (PREPUNISHMENT) SPEEDS IN CM/SEC
GUILLOTINE-DOOR
REGULAR EXTINCTION
GUILLOTINE-DOOR
PUNISHED EXTINCTION
DROP PROCEDURE
PUNISHED EXTINCTION
DROP PROCEDURE
REGULAR EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Figure 15. First segment (prepunishment) running speeds of subjects in the 16 sec confinement groups as a function of drop or guillotine-door starting procedure and punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion.

FIGURE 15

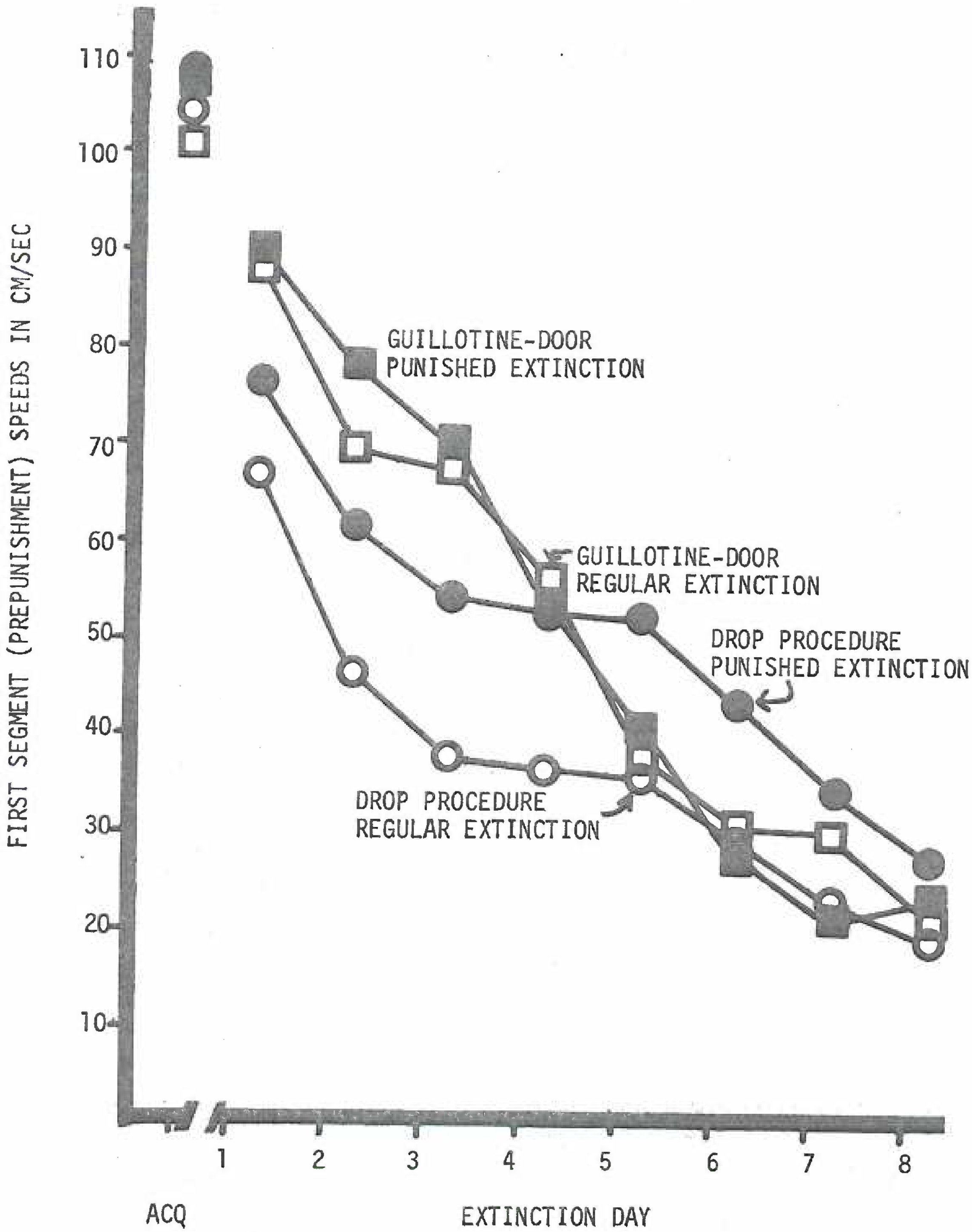

FIRST SEGMENT (PREPUNISHMENT) SPEEDS IN CM/SEC
110
100
90
80
70
60
50
40
30
20
10
GUILLOTINE-DOOR
PUNISHED EXTINCTION
GUILLOTINE-DOOR
REGULAR EXTINCTION
DROP PROCEDURE
PUNISHED EXTINCTION
DROP PROCEDURE
REGULAR EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Figure 16. First segment (prepunishment) running speeds of subjects in the 16 sec confinement groups as a function of drop or guillotine-door starting procedure and punished or regular extinction conditions. The data were compiled according to the prepunishment extinction criterion.

FIGURE 16

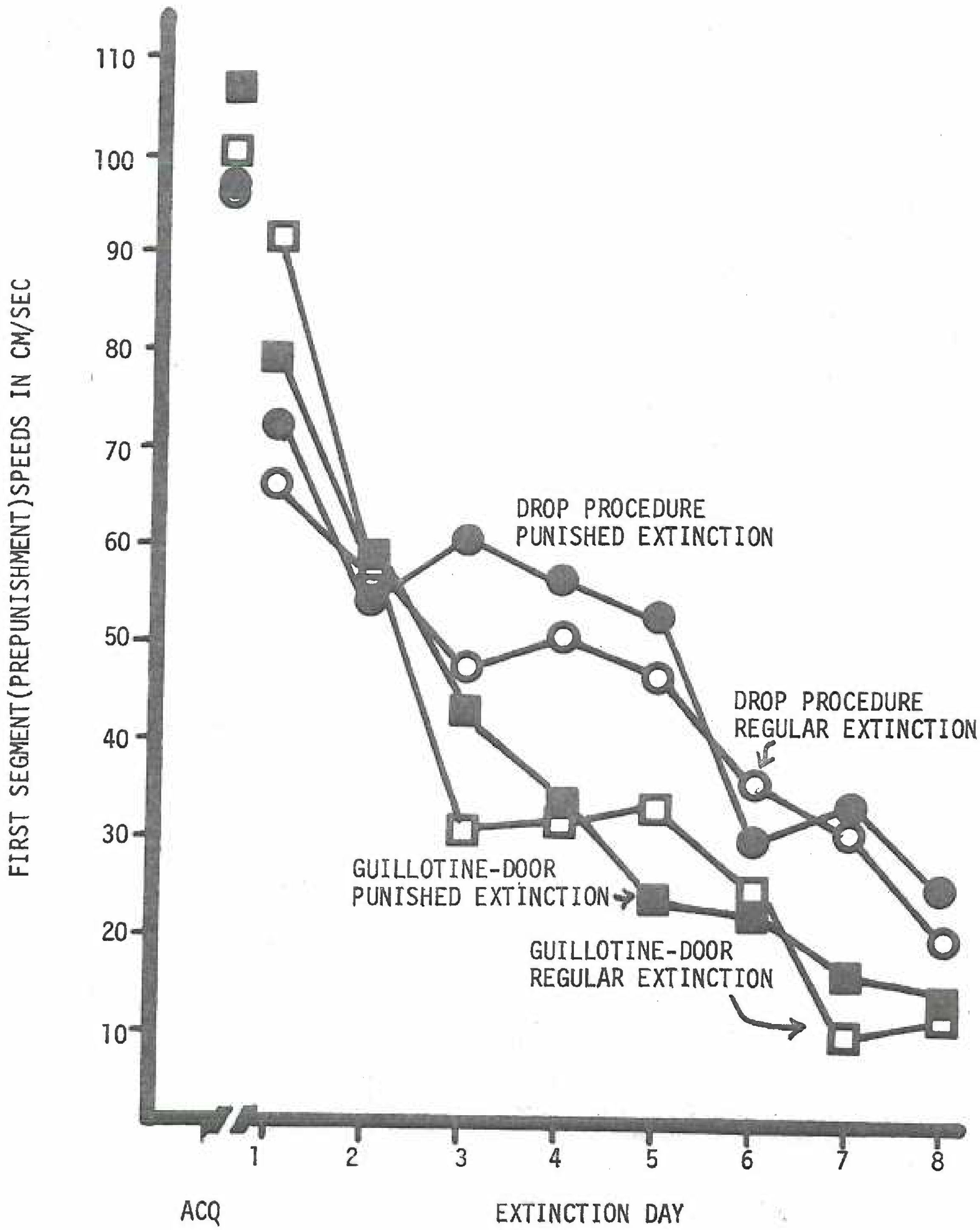

110
100
90
80
70
60
50
40
30
20
10
FIRST SEGMENT(PREPUNISHMENT)SPEEDS IN CM/SEC
DROP PROCEDURE
PUNISHED EXTINCTION
DROP PROCEDURE
REGULAR EXTINCTION
GUILLOTINE-DOOR
PUNISHED EXTINCTION
GUILLOTINE-DOOR
REGULAR EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Table 7 A summary of the analysis of variance applied to starting scores. The data were compiled according to the goalbox extinction criterion.

Source*	df	ms	F	P
T	1	154.8		
S	1	3114.3	1.90	
P	1	2315.7	1.42	
D	7	2972.8	20.81	$<.01$
TS	1	2054.9	1.26	
TP	1	4.7		
SP	1	210.9		
TD	7	241.5	1.69	
SD	7	325.1	2.28	$<.05$
PD	7	366.2	2.56	$<.05$
TSP	1	122.8		
TSD	7	373.8	2.62	$<.05$
TPD	7	93.8		
SPD	7	60.7		
TSPD	7	93.3		
error				
between	72	1634.9		
within	504	142.8		

*T - Starting area confinement time
S - Starting procedure
P - Punished or regular extinction
D - Extinction days

Figure 17. Starting scores as a function of punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion.

FIGURE 17

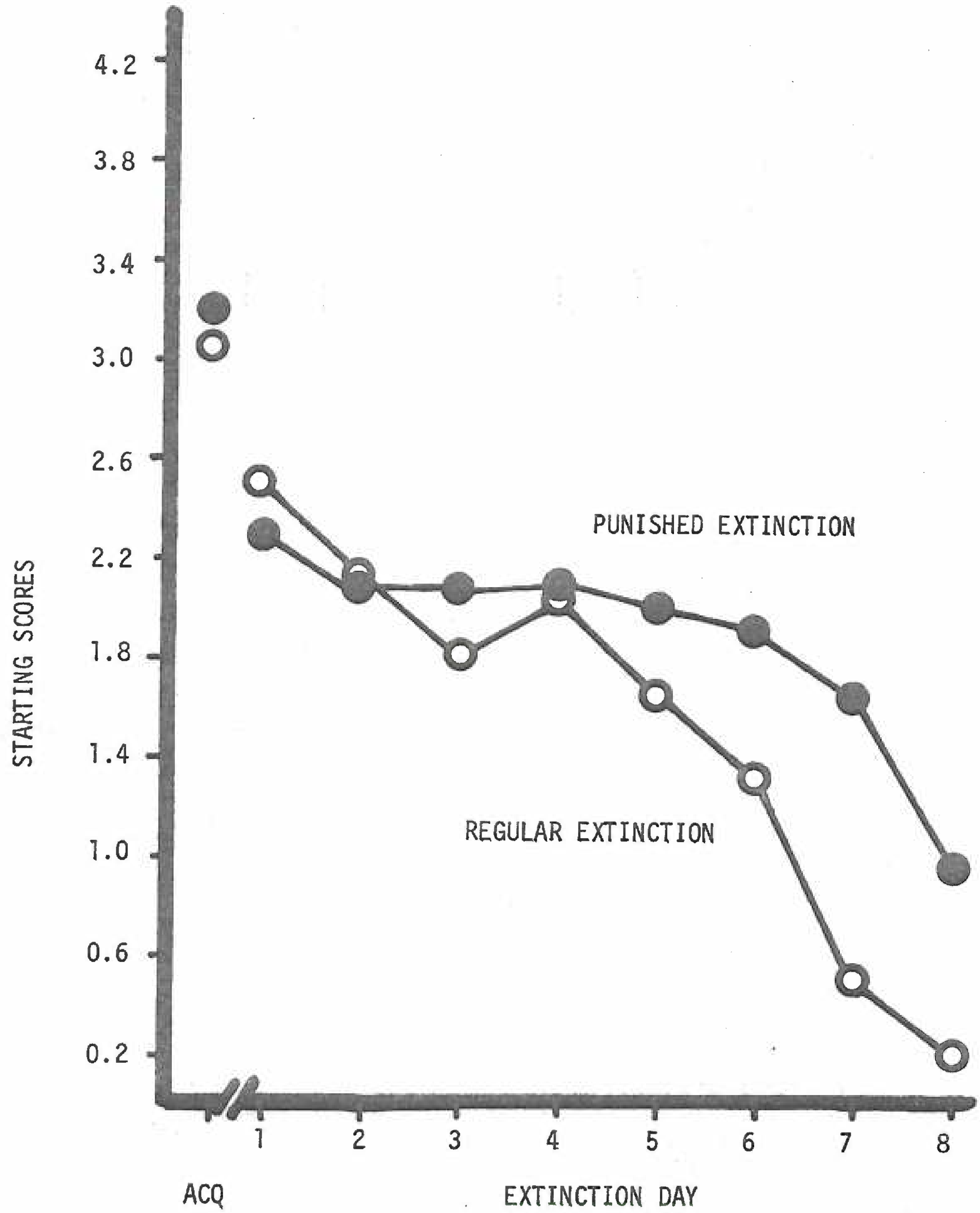
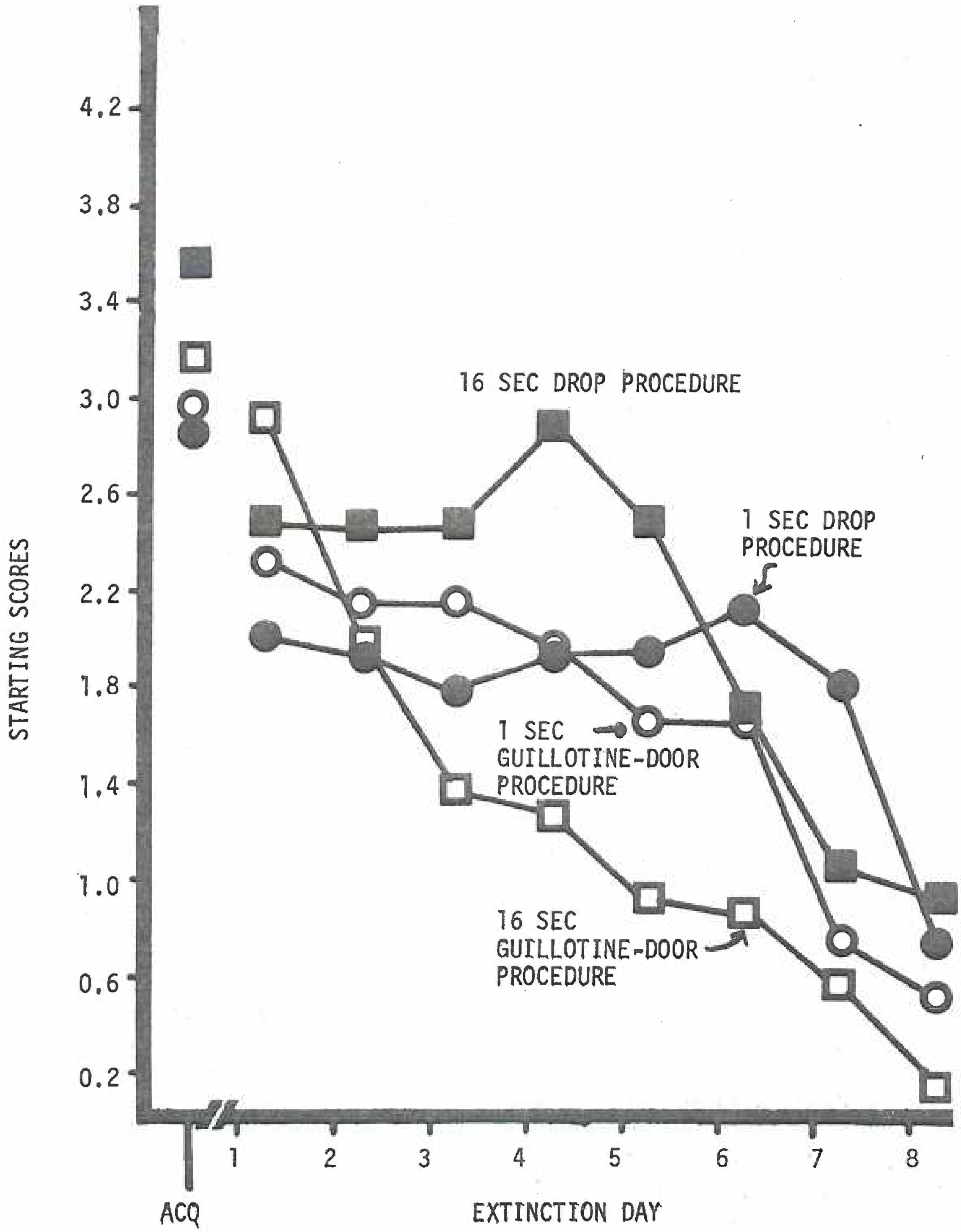

4.2
3.8
3.4
3.0
2.6
2.2
1.8
1.4
1.0
0.6
0.2
STARTING SCORES
PUNISHED EXTINCTION
REGULAR EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Figure 18. Starting scores as a function of drop or guillotine-door procedure and 1 sec or 16 sec starting area confinement time. The data were compiled according to the goalbox extinction criterion.

FIGURE 18


STARTING SCORES
4.2
3.8
3.4
3.0
2.6
2.2
1.8
1.4
1.0
0.6
0.2
16 SEC DROP PROCEDURE
1 SEC DROP PROCEDURE
1 SEC GUILLOTINE-DOOR PROCEDURE
16 SEC GUILLOTINE-DOOR PROCEDURE
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

interaction of days, starting procedure, and confinement time ($F = 2.62$, $p < .05$).

An identical analysis was conducted for prepunishment speeds (shown in Figure 19). Both the visually evident effect of days, and the interaction of days with starting procedure, proved reliable ($F = 81.31$ and 6.17, respectively, $p < .01$). In addition, the three-way interaction of days, starting procedure, and confinement time was significant ($F = 3.36$, $p < .01$). The analysis is summarized in Table 8.

Postpunishment speeds were higher, overall, for punished subjects than nonpunished subjects, as revealed by a reliable main effect of punishment ($F = 10.96$, $p < .01$). In addition, the days effect and and the days by starting procedure interaction (shown in Figure 20). were both significant (F's $= 57.88$ and 2.85, respectively, $p < .01$). The analysis of variance summary is presented in Table 9.

C. <u>Overall analyses compiled according to the extinction criterion of one failure to leave the prepunishment zone.</u> An analysis of starting scores (which are plotted in Figure 21) yielded a reliable main effect of extinction days ($F= 3.30$, $p<.01$), and a significant interaction of starting procedure with days ($F = 2.68$, $p<.01$). The analysis is summarized in Table 10.

Prepunishment speeds (shown in Figure 22) decreased reliably over days ($F = 68.8$, $p < .01$). Although the guillotine-door rats were somewhat faster than drop-start rats at the beginning of acquisition, their respective positions were reversed by the end of extinction, yielding a reliable days by starting procedure interaction ($F = 5.21$, $p < .01$). The three-way interaction, between confinement time, starting

Figure 19. First segment (prepunishment) running speeds as a function of drop or guillotine-door starting procedures and 1 sec or 16 sec starting area confinement times. The data were compiled according to the goalbox extinction criterion.

FIGURE 19

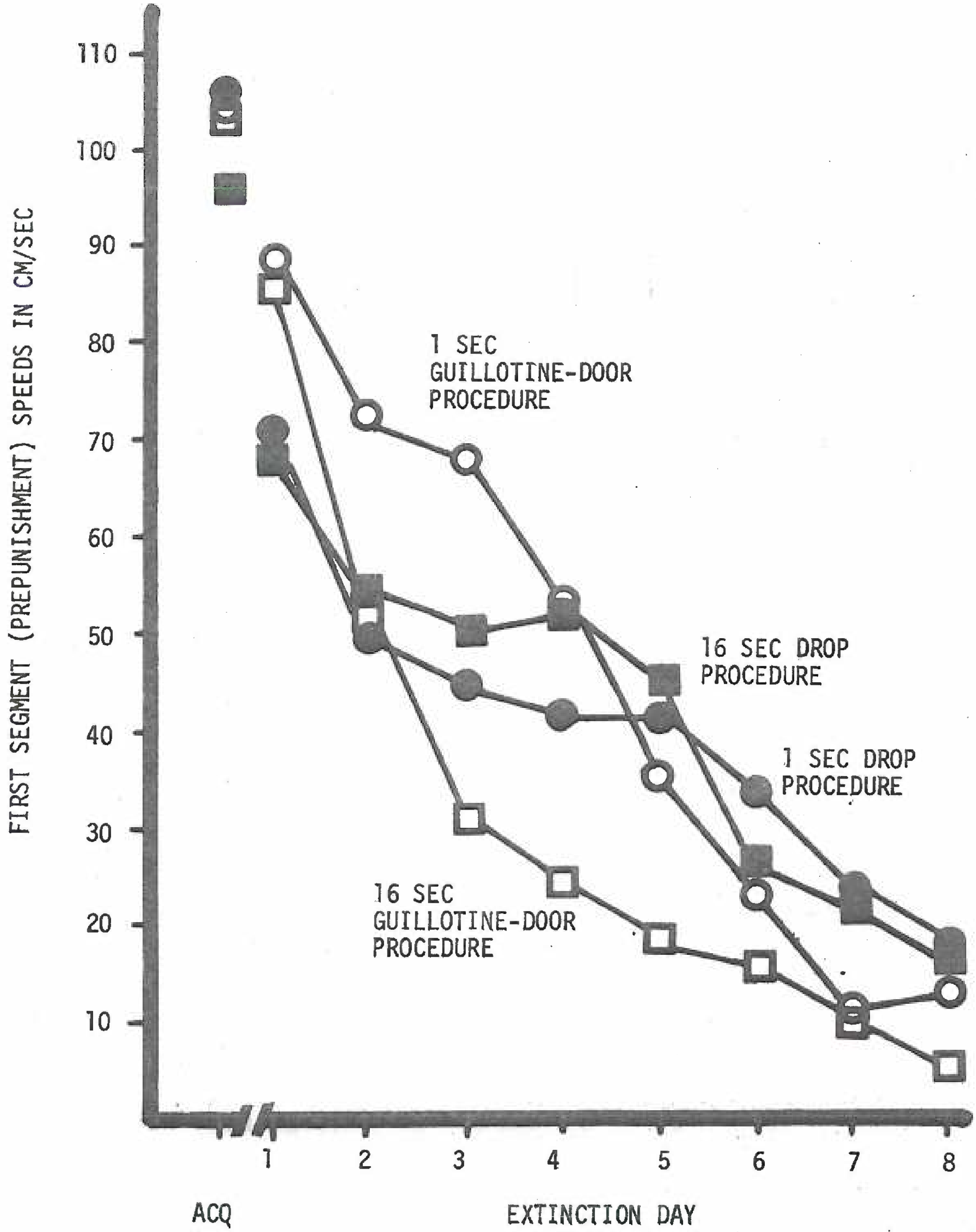

110
100
90
80
70
60
50
40
30
20
10
FIRST SEGMENT (PREPUNISHMENT) SPEEDS IN CM/SEC
1 SEC
GUILLOTINE-DOOR
PROCEDURE
16 SEC DROP
PROCEDURE
1 SEC DROP
PROCEDURE
16 SEC
GUILLOTINE-DOOR
PROCEDURE
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Table 8 An analysis of variance applied to the first segment (prepunishment) running speeds. The data were compiled according to the goalbox extinction criterion.

Source*	df	ms	F	P
T	1	8115.3	1.29	
S	1	1419.0		
P	1	18824.7	3.00	
D	7	38586.0	81.31	< .01
TS	1	11298.0	1.80	
TP	1	885.9		
SP	1	1673.7		
TD	7	367.5		
SD	7	2928.7	6.17	< .01
PD	7	628.4	1.32	
TSP	1	972.6		
TSD	7	1582.9	3.36	< .01
TPD	7	261.5		
SPD	7	103.6		
TSPD	7	354.9		
error				
between	72	6282.2		
within	504	474.5		

*T - Starting area confinement time
S - Starting procedure
P - Punished or regular extinction
D - Extinction days

Figure 20. Third segment (postpunishment) running speeds as a function of drop or guillotine-door starting procedure. The data were compiled according to the goalbox extinction criterion.

FIGURE 20

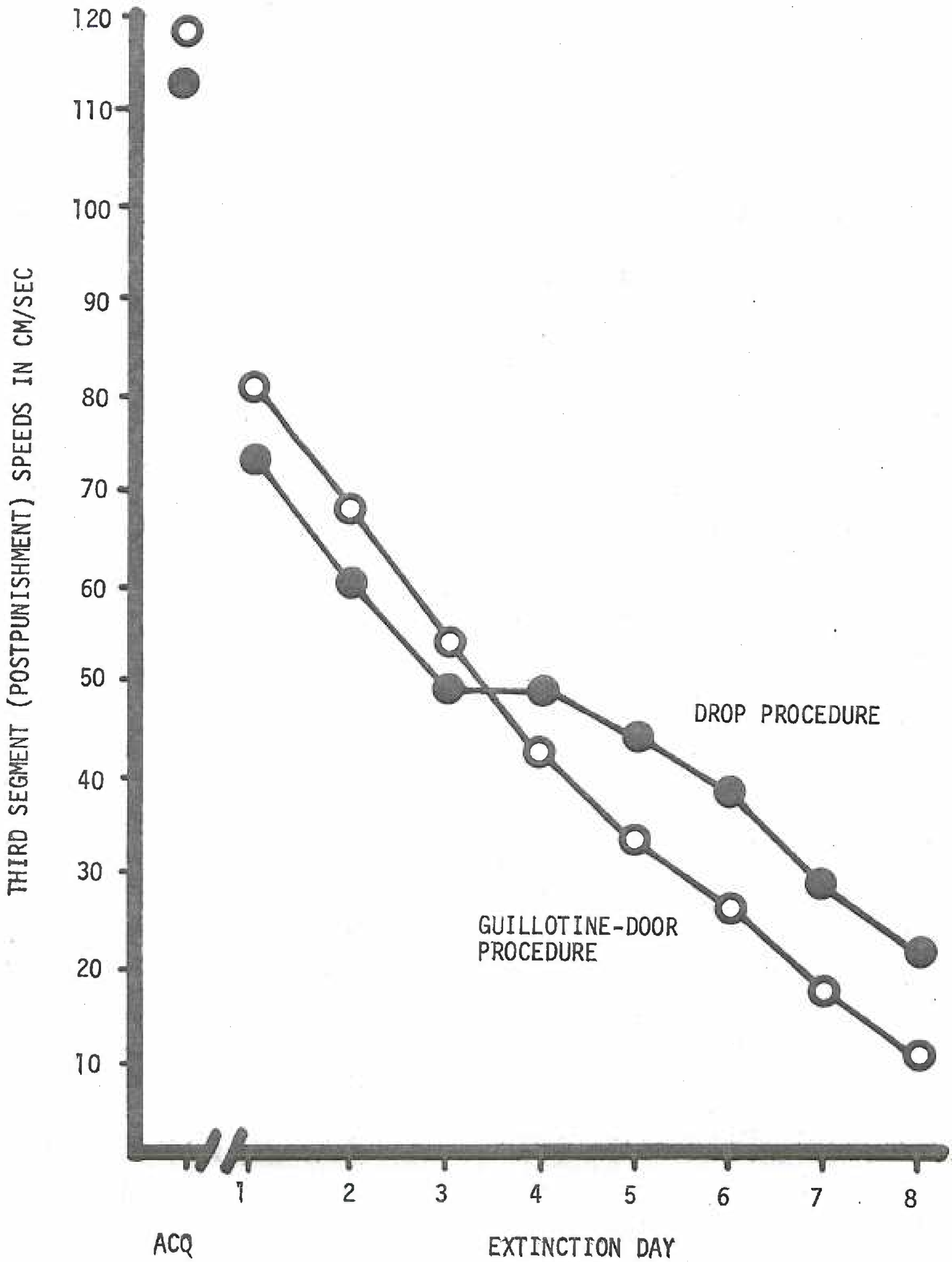

120
110
100
90
80
70
60
50
40
30
20
10
THIRD SEGMENT (POSTPUNISHMENT) SPEEDS IN CM/SEC
DROP PROCEDURE
GUILLOTINE-DOOR PROCEDURE
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

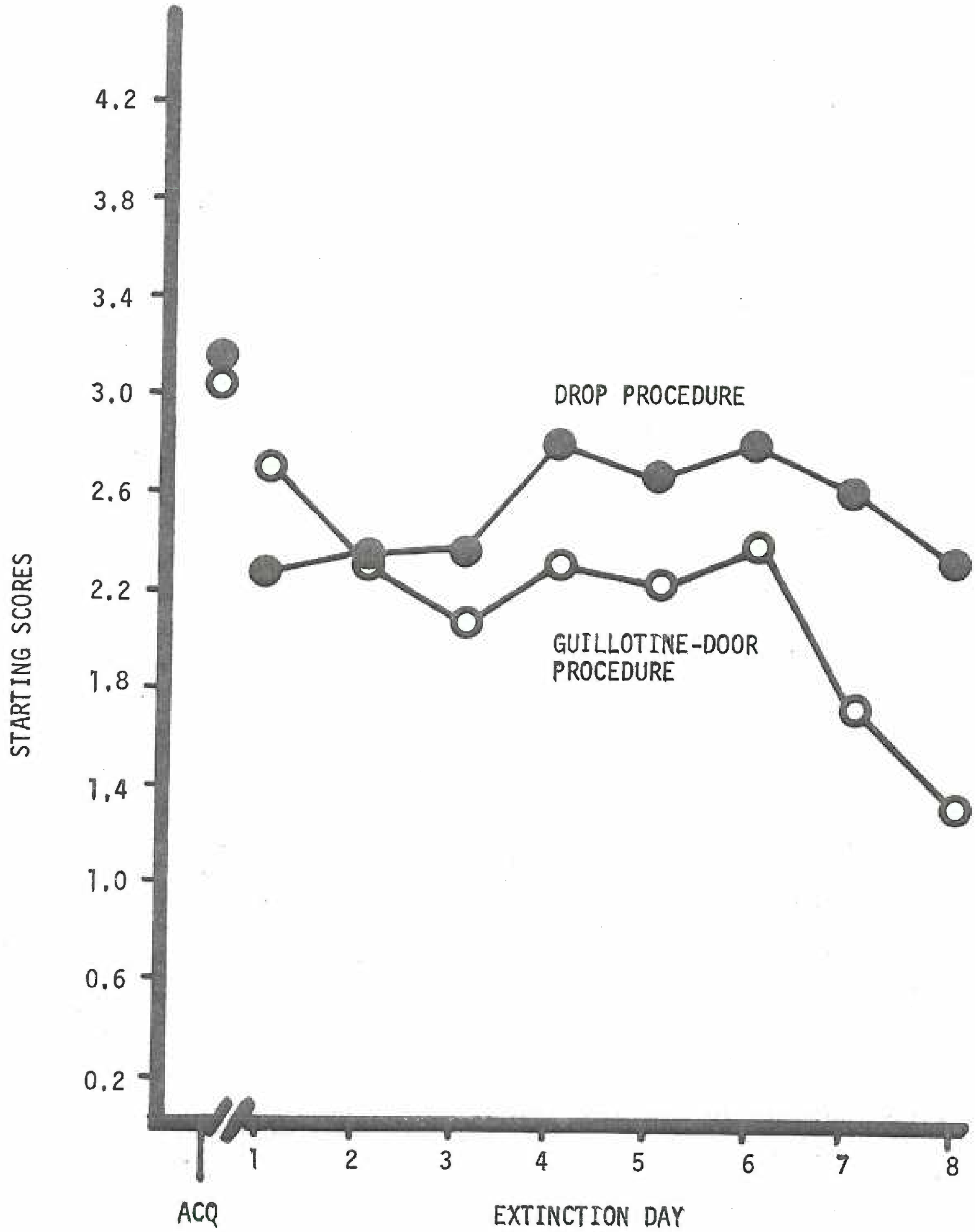
Table 9 A summary of the analysis of variance applied to third segment (postpunishment)running speeds. The data were compiled according to the goalbox extinction criterion.

Source*	df	ms	F	P
T	1	6773.0		
S	1	2168.2		
P	1	78499.6	10.96	$<.01$
D	7	33854.4	57.88	$<.01$
TS	1	15425.2	2.15	
TP	1	3478.2		
SP	1	1562.5		
TD	7	422.7		
SD	7	1668.6	2.85	$<.01$
PD	7	469.5		
TSP	1	225.6		
TSD	7	774.8	1.32	
TPD	7	336.9		
SPD	7	606.2	1.04	
TSPD	7	323.9		
error				
between	72	7164.6		
within	504	584.8		

*T - Starting area confinement time
S - Starting procedure
P - Punished or regular extinction
D - Extinction days

Figure 21. Starting scores as a function of drop or guillotine-door starting procedures. The data were compiled according to the prepunishment extinction criterion.

FIGURE 21



4.2
3.8
3.4
3.0
2.6
2.2
1.8
1.4
1.0
0.6
0.2
STARTING SCORES
DROP PROCEDURE
GUILLOTINE-DOOR
PROCEDURE
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

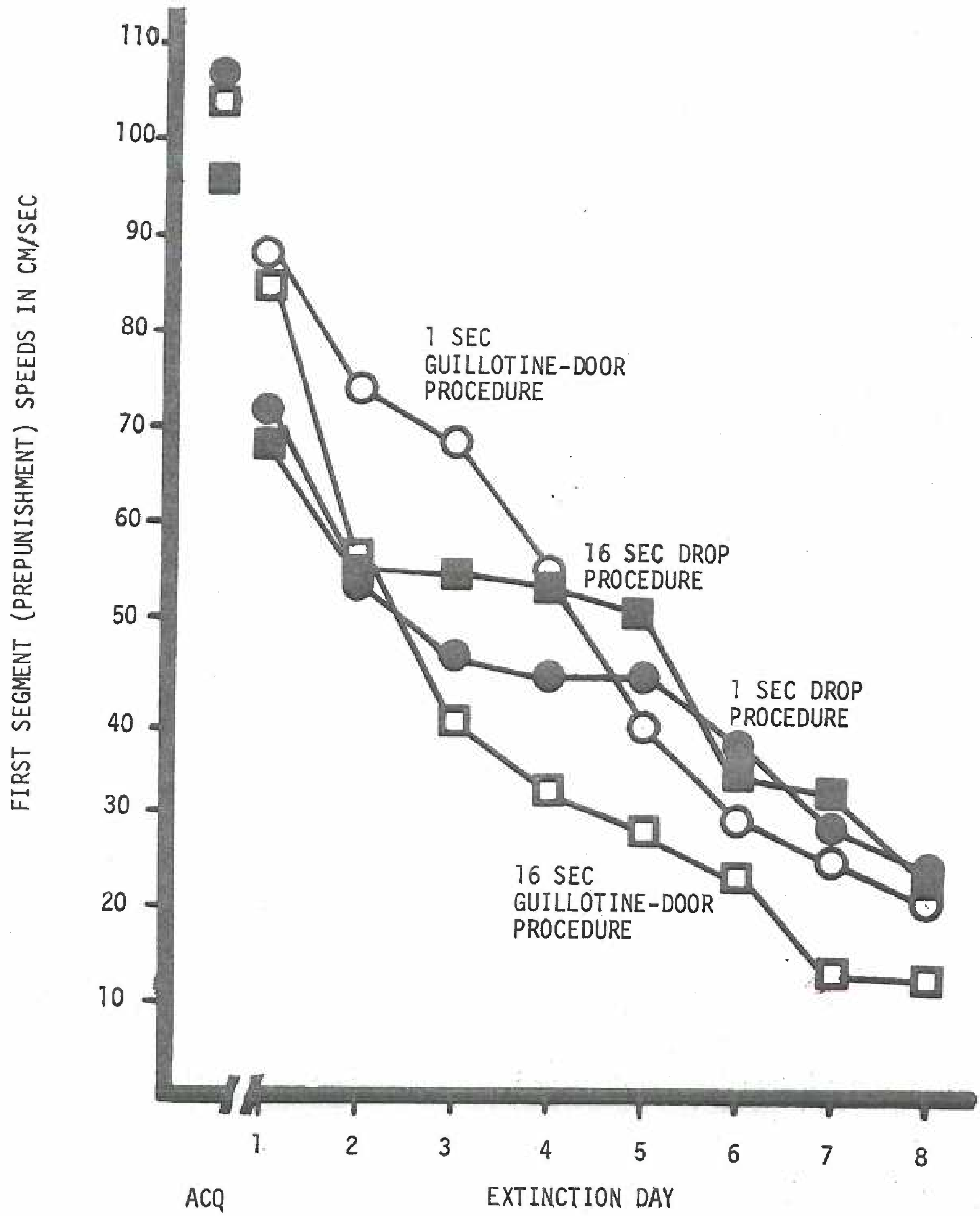
Table 10 A summary of the analysis of variance applied to starting scores. The data were compiled according to the prepunishment extinction criterion.

Source*	df	ms	F	P
T	1	28.7		
S	1	3334.2	1.73	
P	1	5206.3	2.70	
D	7	509.3	3.30	< .01
TS	1	2289.9	1.18	
TP	1	821.7		
SP	1	620.9		
TD	7	151.9	1.01	
SD	7	402.9	2.68	< .01
PD	7	272.0	1.81	
TSP	1	77.7		
TSD	7	171.1	1.14	
TPD	7	102.6		
SPD	7	112.4		
TSPD	7	142.2		
error				
between	72	1927.2		
within	504	149.9		

*T - Starting area confinement time
S - Starting procedure
P - Punished or regular extinction
D - Extinction days

Figure 22. First segment (prepunishment) running speeds as a function of drop or guillotine-door starting procedure and 1 sec or 16 sec starting area confinement times. The data were compiled according to the prepunishment extinction criterion.

FIGURE 22


FIRST SEGMENT (PREPUNISHMENT) SPEEDS IN CM/SEC
110
100
90
80
70
60
50
40
30
20
10
1 SEC
GUILLOTINE-DOOR
PROCEDURE
16 SEC DROP
PROCEDURE
1 SEC DROP
PROCEDURE
16 SEC
GUILLOTINE-DOOR
PROCEDURE
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

procedure, and days, also proved reliable ($F = 2.14$, $p < .05$). Table 11 provides a summary of this analysis.

D. Trials to extinction. Rats which met an extinction criterion were assigned a score corresponding to the number of trials required to reach that criterion, including the trial on which it was met, as in the first experiment. Mean scores for each group and each extinction criterion are shown in Table 12.

1. A priori statistical tests. Statistical comparisons of the degree to which punishment affected resistance to extinction for drop-start vs. guillotine-door rats were conducted at each of the confinement intervals using two-way interaction contrasts. The difference between mean trials to extinction for punished and nonpunished rats in the drop-start groups was subtracted from that difference for rats in the guillotine-door groups, the result squared, multiplied by 5 (one half the subjects per group) and divided by the mean square error term from the overall analysis, thus forming an F-ratio with 1 and 72 degrees of freedom. The results, at each of the confinement intervals, and with each of the extinction criteria, yielded F-ratios which failed to reach acceptable levels of significance (all F's $\leqslant 2.47$, $p \geqslant .120$). Thus, the preplanned tests failed to indicate any differential effects of punishment on resistance to extinction for drop-start or guillotine-door rats when their startbox confinement times were equated.

2. Overall analyses. Following the preplanned comparisons overall analyses of the data were conducted. For data compiled with the extinction criterion of one failure to enter the goalbox there were no reliable effects of any of the three factors, confinement time,

Table 11 A summary of the analysis of variance applied to first segment (prepunishment) running speeds. The data were compiled according to the prepunishment extinction criterion.

Source*	df	ms	F	P
T	1	5365.0		
S	1	542.0		
P	1	2902.7		
D	7	30203.7	68.80	< .01
TS	1	11399.0	1.76	
TP	1	1053.1		
SP	1	2860.3		
TD	7	183.4		
SD	7	2288.5	5.21	< .01
PD	7	215.8		
TSP	1	807.7		
TSD	7	938.8	2.14	< .05
TPD	7	182.9		
SPD	7	107.7		
TSPD	7	167.4		
error				
between	72	6472.4		
within	504	439.0		

*T - Starting area confinement time
S - Starting procedure
P - Punished or regular extinction
D - Extinction days

Table 12 Mean trials to extinction as a function of extinction treatment and extinction criterion.

One failure to enter the goalbox

	1-sec: Regular Extinction	1-sec: Punished Extinction	16-sec: Regular Extinction	16-sec: Punished Extinction
Drop-start	15.9	19.3	20.3	18.8
Guillotine-door start	18.1	23.4	11.5	7.0

One failure to leave the prepunishment zone

	1-sec: Regular Extinction	1-sec: Punished Extinction	16-sec: Regular Extinction	16-sec: Punished Extinction
Drop-start	27.5	21.0	31.7	21.5
Guillotine-door start	27.9	25.1	28.0	19.7

starting procedure, or presence of punishment, and no significant interactions. A similar analysis, conducted on the prepunishment criterion data, revealed only one reliable effect: punished rats completed fewer trials, overall, than nonpunished rats ($F = 11.06$, $p < .01$).

Discussion

The preplanned tests indicated no differential effects of punishment for rats given the two different starting procedures with confinement times equated, although such differences might have been predicted by Delude's innate fear hypothesis of self-punitive behavior. They were, instead, consistent with the Mowrer-Brown motivational-associative hypothesis. Neither position received much support, however. Save for the analyses of starting scores and postshock speeds compiled with the traditional extinction criterion there was no reliable evidence of self-punitive behavior in this experiment. The anticipated superiority, in terms of prepunishment running speeds, of punished over nonpunished subjects, did not materialize. In terms of the two dependent measures which did reveal evidence of self-punitive behavior, the effects of punishment interacted with neither confinement time nor starting procedure. The most reliable outcome of the experiment was that rats dropped into the starting area at the beginning of the experiment ran faster over trials than those which were gently placed there in following the guillotine-door procedure. This interaction proved reliable in each of the five analyses. Finally, the three-way interaction of days, starting procedure, and confinement time was reliable for prepunishment speeds compiled with both criteria, and starting scores compiled with the goalbox extinction criterion.

The most puzzling outcome of this experiment was the failure of the 1-sec guillotine-door groups to behave like those in the first experiment. They received nearly the same treatment as the 1-sec groups given controlled handling in the first experiment. Nevertheless, strong self-punitive running was shown by rats in the first experiment but not in the second. Not even the drop-start rats, which according to the results of Delprato and Meltzer and of Delude would have been expected to display strong punishment-produced response facilitation, did so.

A careful analysis of the procedures used in these experiments revealed two differences between the treatment of the 1-sec groups given controlled handling in the first experiment and the 1-sec guillotine-door rats in the second. First, the rats in Experiment 1 were given all trials during acquisition with the guillotine-door procedure while those in the second experiment were given only half their trials with that procedure and half with the drop-start procedure. Second, those rats in the first experiment were picked up about 20 sec prior to each trial, placed on the experimenter's arm, and returned to their carrying cage, while those in the second experiment were picked up, held in the upper starting chamber for 1 sec, placed on the starting area grid floor, and then immediately returned to their carrying cage.

Acquisition speeds differed little between the two experiments while starting scores were even higher in the second than the first. From these data, at least, there is little evidence to suggest that the training regimen in the second experiment was inferior to that in the first. The second difference appears to hold more promise as an explanation of the data. It would seem that the extra exposure to starting area cues, which the experimenter believed would serve primarily as a control to equate all groups for handling, actually was of substantial importance in its effect upon the performance of subjects in the 1-sec groups. This extra exposure can be thought of in two ways, either as being an additional CS onset, which was nonreinforced, or as adding to the total or cummulative duration of CS exposure. By either mechanism one could predict poorer performance for subjects in the second experiment, which were given the extra startbox exposure, than for those in the first experiment, which were not. Both would predict lower fear levels and/or a weakened tendency to initiate locomotor responding for subjects in the second experiment. Such an interpretation would be in accord with the empirical results of the first experiment, as well as with those of Cunningham et al. (1975), and others

The fact that rats started with the drop-procedure performed better during extinction than those started with the guillotine-door procedure was consistent with the results of the three previous experiments making these comparisons. The differences, as noted previously, could be accounted for by either Delude's notion that the drop-procedure is innately fear-arousing, or Brown's idea that the cues attending being dropped are particularly salient stimuli to which fear and/or locomotor responding can be easily conditioned.

An inspection of the three-way interactions of days, confinement time, and starting procedure indicated that they were quite complex. Not only did guillotine-door subjects perform better at the beginning of extinction and worse at the end of extinction than drop-start subjects, but better extinction performance was displayed by 1-sec guillotine-door subjects than 16-sec subjects while only marginal differences existed between drop-start groups. No simple explanation of this interaction is readily apparent.

In summary, it would appear that this experiment was not successful in providing answers to the questions asked. Although no reliable differences were found between the effects of punishment on extinction performance with the drop-start and guillotine-door groups given equivalent starting times, these results were not very convincing because only marginal punishment-produced response facilitation was shown in the experiment. The extra starting-area exposure, which was given 1-sec rats as a control procedure, was implicated as a possible cause for the failure to demonstrate strong self-punitive running.

EXPERIMENT 3

Introduction

Several hypotheses were examined in evaluating the lack of reliable self-punitive responding in the second experiment. The most appealing of these was that the extra exposure to starting area cues received by the 1-sec animals in that experiment was sufficient to reduce substantially their fear and/or locomotor responding to those cues. This may have been responsible for the finding that they differed little, and unreliably, from the 16-sec rats in the second experiment, and like the 16-sec rats in Experiment 1, demonstrated only marginal, and generally unreliable, self-punitive running.

The third experiment, like the second, was designed to compare the drop and guillotine-door procedures. In this experiment, however, the extra exposure to starting area cues was eliminated, and only 1-sec starting area confinements were used. Because even the short extra exposure seemed sufficient to disrupt the self-punitive behavior of rats in the 1-sec groups in Experiment 2, it hardly seemed necessary to run the 16-sec delay groups in the third experiment. They would have received even greater exposure to starting area stimuli than the 1-sec subjects in the second experiment, which did not run self-punitively. In addition, 16-sec subjects in neither the first nor second experiment had shown any sign of reliable self-punitive running.

A 2 x 2 x days factorial design was followed. One factor was drop-starting vs. guillotine-door starting and the second was punished vs. regular extinction. Again, extinction data were compiled according to both the traditional criterion of one failure to enter the goalbox, and the criterion of one failure to leave the prepunishment zone, within 60 sec.

Method

Subjects. The subjects were 47 naive female albino rats (Sprague-Dawley derivatives from Charles River, Inc., Wilmington, Mass). They were 65-75 days old at the beginning of the experiment and weighed between 196 and 241 gm. They were individually housed and maintained on an ad lib food and water regimen.

Apparatus. The apparatus was identical to that used in the second experiment.

Procedure. The general procedure, as in the first and second experiments, consisted of shock-escape training followed by regular or punished extinction. Extinction trials were given with either the drop-starting procedure or the guillotine-door procedure; starting area confinement was 1 sec for rats run with both procedures. As in the first and second experiments the timing on every trial began when the startbox guillotine-door was raised, and terminated when the goalbox guillotine-door was lowered. Again, following 25-30 sec goalbox confinement the rats were removed to their individual carrying cages. Four trials a day were administered with an intertrial-interval of 35-50 min.

On Day 1 of the experiment, each rat was handled, weighed, and marked as in the first two experiments. On Days 2-7 an acquisition regimen consisting of three shaping days with progressively longer segments of the alley and increasing shock intensities, and three full-alley shock-escape days, was utilized in the first and second experiment.

On each of the acquisition days, two of the trials, in randomly determined order, were run with the drop-start procedure and two with the guillotine-door procedure. On trials with the drop-start procedure the rats were placed in the upper compartment of the bi-level starting chamber for 1-sec. The trapdoor-floor was then released, dropping them into the starting area. One sec later the guillotine-door was raised, permitting them to traverse the alley. Those run with the guillotine-door procedure were held by hand for 1-sec in the upper chamber of the starting box, and then gently lowered to the grid-floor of the starting area below. One sec later the guillotine-door was raised and the trial began. Thus, the two procedures were equated for starting area confinement time, exposure to upper starting chamber cues, and handling. They differed only in that with one procedure the rats were dropped into the lower starting area and with the other they were gently placed into it. As in the previous experiments, because all rats were given the same number of drop and guillotine-door trials during acquisition, it was expected that they would all experience the same degree of stimulus generalization decrement when switched to their extinction regimens.

After the sixth day of acquisition, the required number of "runners" was selected to receive the final day of acquisition training and extinction. Following Day 7 these rats were randomly assigned to one of two groups, one receiving all trials with the drop-start procedure, and the other with the guillotine-door procedure. Half of the rats in each group were given regular extinction, while the other half were given punished extinction with shock in only the middle 61-cm segment of the alley. Extinction trials continued at the rate of four per day, until each rat met both the traditional goalbox extinction criterion and the prepunishment criterion, or completed eight extinction days.

All animals were run in a single replication. Of the 47 rats given acquisition training 2 were discarded as "posturers" and 1 was randomly eliminated, leaving 11 "runners" in each of the 4 extinction groups.

Results

Escape acquisition. Mean starting scores, first 61-cm segment speeds and third 61-cm segment speeds for each rat for the last day of acquisition were subjected to analyses of variance with the two extinction pseudofactors, starting procedure and type of extinction. The results indicated only one reliable effect: rats run during the subsequent extinction phase with the drop-start procedure had reliably higher speeds in the first segment during acquisition than those run with the guillotine-door procedure during extinction ($F = 4.65$, $p = .037$, df 1,40).

Extinction. Mean starting scores, and preshock (first 61-cm segment) and postshock (third 61-cm segment) running speeds were compiled with each extinction criterion as in the first and second experiments. As in those experiments rats were assigned the minimum starting scores of .07 and running speeds of 4.1 cm/sec on the trial on which they extinguished and each trial thereafter.

A. A priori statistical tests. The basic question asked in this experiment was whether, with starting-area confinement time held constant, rats run with the drop-start procedure would demonstrate more self-punitive behavior than those with the guillotine-door procedure. As in the second experiment three-way contrasts were used to test the hypothesis directly. The results confirmed what appeared visually evident from an inspection of the data, which are shown in Figures 23 and 24. Little evidence of a reliable interaction was revealed when the traditional extinction criterion was employed ($F = 2.92$, $p = .089$, df 1, 280). But when the prepunishment extinction criterion was used different results were obtained. The three-way comparison was highly significant ($F = 7.82$, $p < .01$) indicating that the degree of punishment-produced response facilitation differed between rats run with the drop-start and the guillotine-door procedure. Followup two-way contrasts revealed that the self-punitive effect was demonstrated by punished subjects run with the drop-start procedure but not by those run with the guillotine-door procedure ($F = 6.32$, $p < .05$, and $F < 1$, respectively).

B. <u>Overall analyses of data compiled with the extinction criterion of one failure to enter the goalbox</u>. Starting scores (shown in Figure 25) were subjected to an analysis of variance having as factors extinction days, punishment, and starting procedure. The analysis (summarized in Table 13) indicated a reliable decline in running speeds over days ($F = 15.83$, $p < .01$) as well as a reliable interaction between the presence of punishment and the effect of extinction days ($F = 3.46$, $p < .01$). Thus, the visual evidence of self-punitive running was confirmed by the statistical analysis. In addition, a reliable main effect of starting procedure was revealed ($F = 11.90$, $p < .01$). Rats with the drop-start procedure had higher starting scores, overall,

Figure 23. First segment (prepunishment) running speeds as a function of drop or guillotine-door starting procedure and punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion.

FIGURE 23

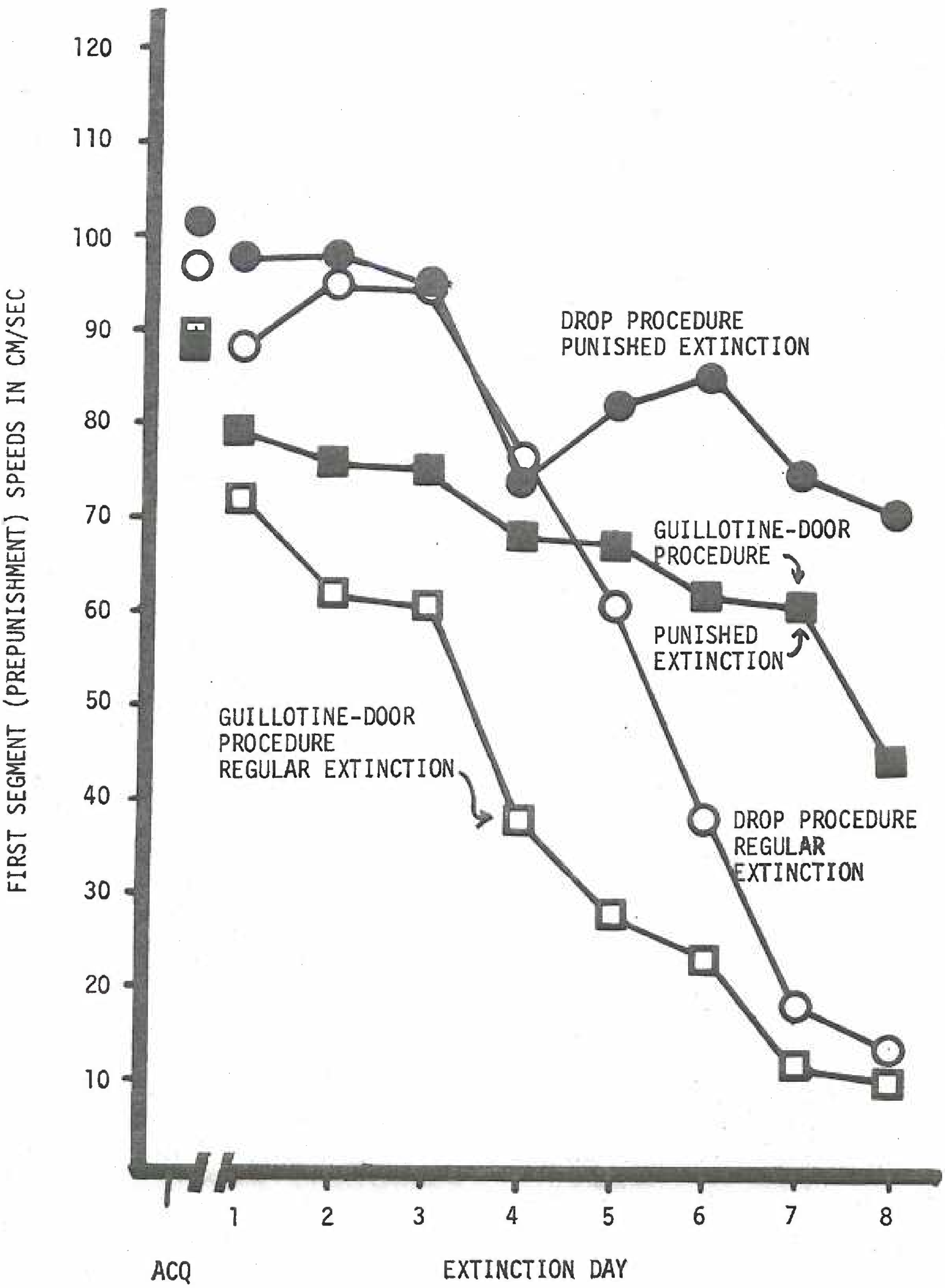

120
110
100
90
80
70
60
50
40
30
20
10
FIRST SEGMENT (PREPUNISHMENT) SPEEDS IN CM/SEC
DROP PROCEDURE
PUNISHED EXTINCTION
GUILLOTINE-DOOR
PROCEDURE
PUNISHED
EXTINCTION
GUILLOTINE-DOOR
PROCEDURE
REGULAR EXTINCTION
DROP PROCEDURE
REGULAR
EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Figure 24. First segment (prepunishment) running speeds as a function of drop or guillotine-door starting procedure and punished or nonpunished extinction conditions. The data were compiled according to the prepunishment extinction criterion.

FIGURE 24

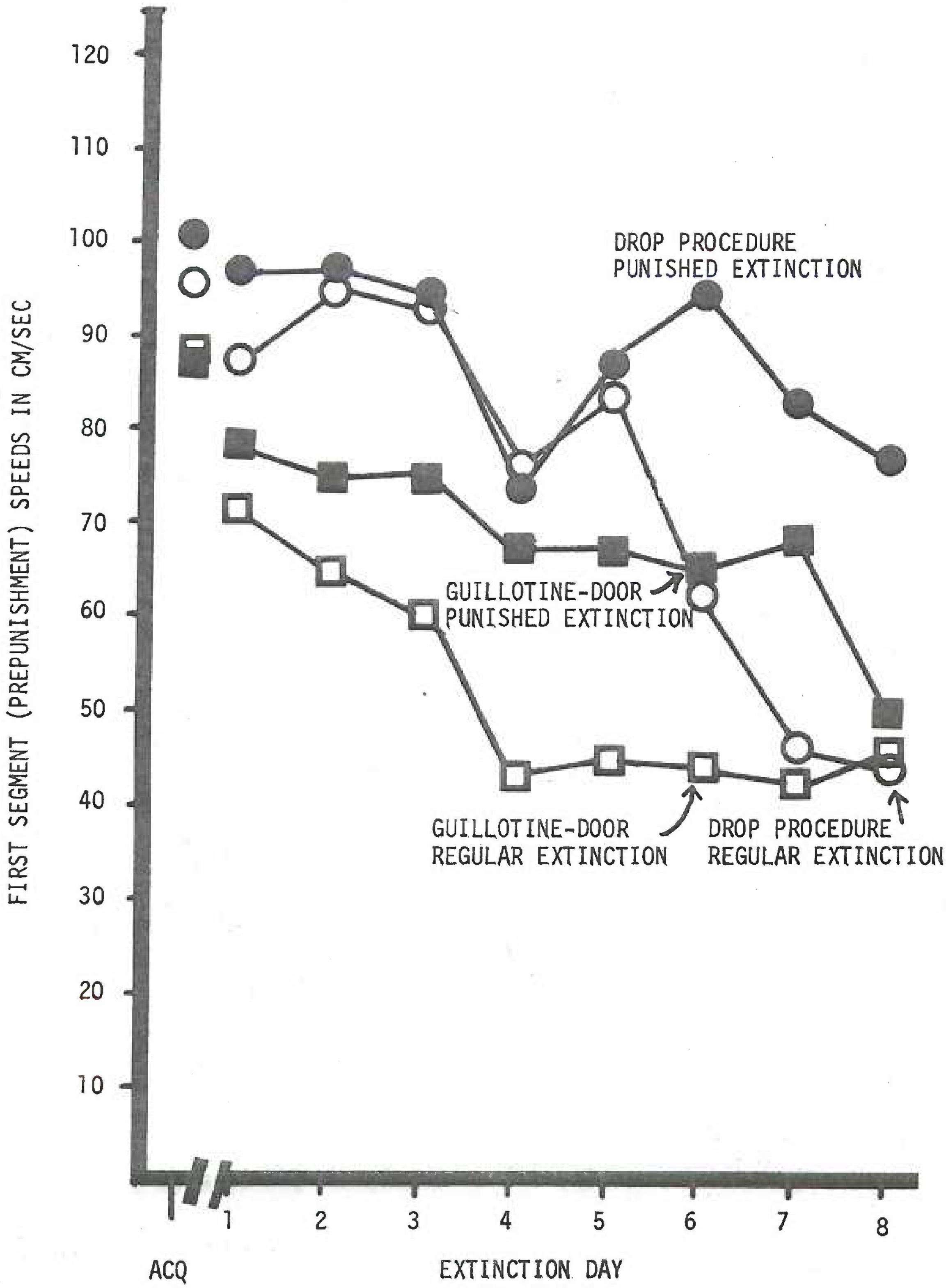

FIRST SEGMENT (PREPUNISHMENT) SPEEDS IN CM/SEC
120
110
100
90
80
70
60
50
40
30
20
10
DROP PROCEDURE
PUNISHED EXTINCTION
GUILLOTINE-DOOR
PUNISHED EXTINCTION
GUILLOTINE-DOOR
REGULAR EXTINCTION
DROP PROCEDURE
REGULAR EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Figure 25. Starting scores as a function of punished or regular extinction conditions and guillotine-door or drop starting procedures. The data were compiled according to the goalbox extinction criterion.

FIGURE 25

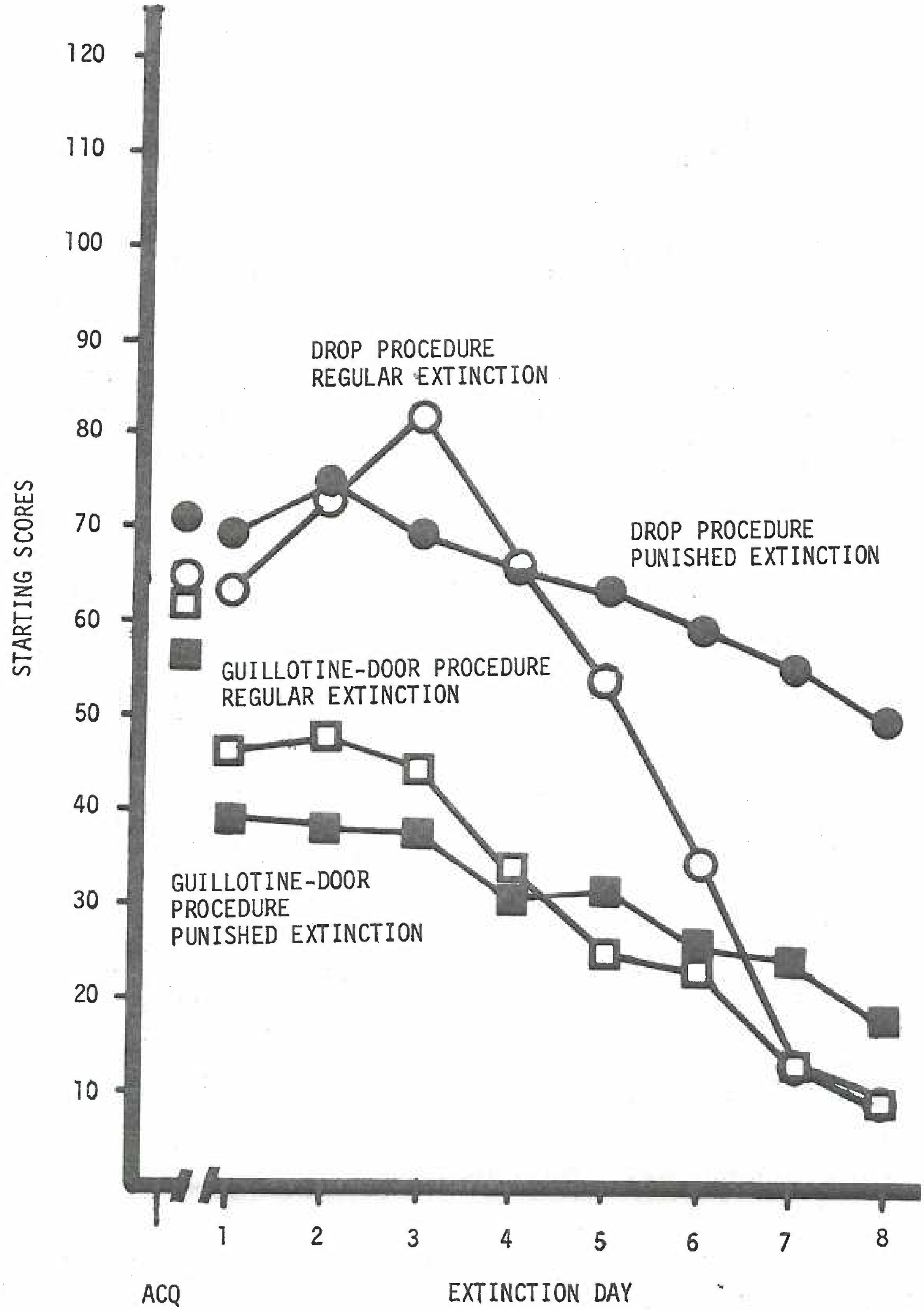

120
110
100
90
80
70
60
50
40
30
20
10
STARTING SCORES
DROP PROCEDURE
REGULAR EXTINCTION
DROP PROCEDURE
PUNISHED EXTINCTION
GUILLOTINE-DOOR PROCEDURE
REGULAR EXTINCTION
GUILLOTINE-DOOR
PROCEDURE
PUNISHED EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Table 13 A summary of the analysis of variance applied to starting scores. The data were compiled according to the goalbox extinction criterion.

Source*	df	ms	F	P
P	1	4471.6		
S	1	57359.7	11.90	< .01
D	7	8896.4	15.83	< .01
PS	1	4397.8		
PD	7	1946.2	3.46	< .01
SD	7	616.6	1.09	
PSD	7	517.5		
error				
between	40	481.6		
within	280	561.8		

*P - Punished or regular extinction
S - Starting procedure
D - Extinction days

than those with the guillotine-door procedure. The starting procedure, however, did not interact with any other factor.

Prepunishment speeds, shown in Figure 24, revealed similar relationships. Again, the visually evident effect of punishment and extinction days, as well as the days by punishment interaction, was supported by reliable effects and interactions in the analysis ($F = 6.75$, 29.02, and 7.09, respectively, all p's $< .01$). The analysis is summarized in Table 14.

Finally, the analysis of postpunishment speeds (summarized in Table 15) indicated the same relationships as the prepunishment speeds. Again, the effects of punishment and days, and the days by punishment interaction were reliable ($F = 26.62$, $p < .01$; $F = 4.83$, $p < .05$; and $F = 8.65$, $p < .01$, respectively). These data are plotted in Figure 26.

C. Overall analyses of data compiled according to the extinction criterion of one failure to leave the prepunishment zone. The analysis of starting scores yielded only the reliable effect of starting procedure ($F = 15.29$, $p < .01$). Rats run with the drop-procedure maintained consistently higher starting scores than those with the guillotine-door procedure. The analysis is summarized in Table 16.

The analysis of prepunishment speeds (see Table 17), plotted in Figure 24, yielded only slightly different results. The effects of starting procedure ($F = 4.43$, $p < .05$) and extinction days both proved reliable ($F = 10.16$, $p < .01$). The three-way interaction of days, punishment, and starting procedure approached significance ($F = 1.83$, $p = .082$). Had this interaction proved reliable the results would have been consistent with those of Delude and Delprato and Meltzer.

Table 14 A summary of the analysis of variance applied to first segment (prepunishment) running speeds. The data were compiled according to the goalbox extinction criterion.

Source*	df	ms	F	P
P	1	60926.5	6.75	< .05
S	1	35140.0	3.89	
D	7	16159.9	29.02	< .01
PS	1	438.7		
PD	7	3946.5	7.08	< .01
SD	7	414.5		
PSD	7	875.4	1.57	
error				
between	40	9026.3		
within	280	556.7		

*P - Punished or regular extinction
S - Starting procedure
D - Extinction days

Table 15 A summary of the analysis of variance applied to third segment (postpunishment) running speeds. The data were compiled according to the goalbox extinction criterion.

Source*	df	ms	F	P
P	1	34741.5	4.83	< .05
S	1	19605.4	2.73	
D	7	9583.5	26.62	< .01
PS	1	48.7		
PD	7	3117.1	8.65	< .01
SD	7	279.3		
PSD	7	453.0	1.26	
error				
between	40	7180.5		
within	280	359.9		

*P - Punished or regular extinction
S - Starting procedure
D - Extinction days

Figure 26. Third segment (postpunishment) running speeds as a function of drop or guillotine-door starting procedures and punished or regular extinction conditions. The data were compiled according to the goalbox extinction criterion.

FIGURE 26

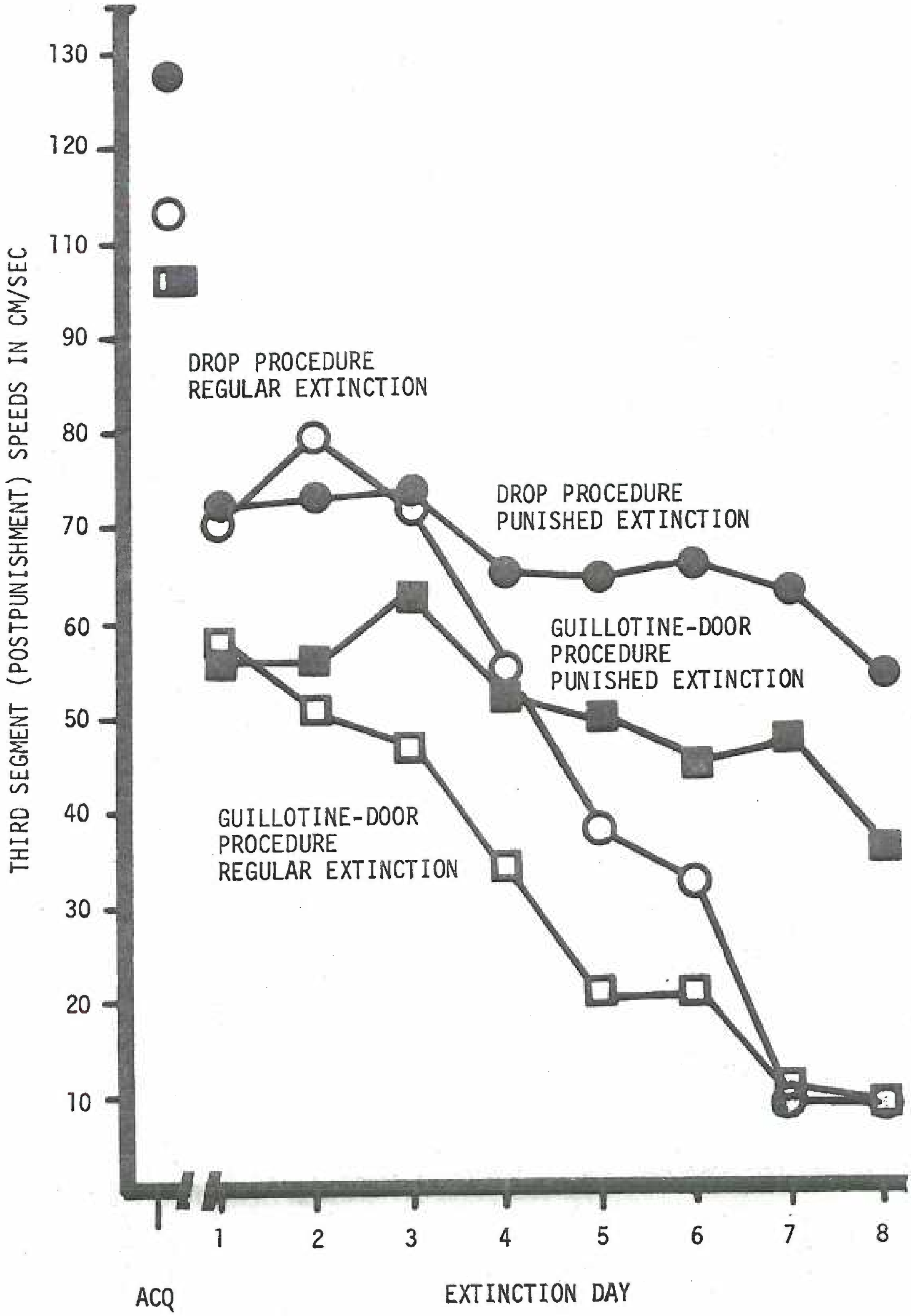

130
120
110
90
80
70
60
50
40
30
20
10
THIRD SEGMENT (POSTPUNISHMENT) SPEEDS IN CM/SEC
DROP PROCEDURE
REGULAR EXTINCTION
DROP PROCEDURE
PUNISHED EXTINCTION
GUILLOTINE-DOOR
PROCEDURE
PUNISHED EXTINCTION
GUILLOTINE-DOOR
PROCEDURE
REGULAR EXTINCTION
1
2
3
4
5
6
7
8
ACQ
EXTINCTION DAY

Table 16 A summary of the analysis of variance applied to starting scores. The data were compiled according to the prepunishment extinction criterion.

Source*	df	ms	F	P
P	1	15931.5	3.23	
S	1	75251.4	15.29	< .01
D	7	775.7	1.64	
PS	1	2912.4		
PD	7	835.4	1.76	
SD	7	156.7		
PSD	7	180.2		
error				
between	40	4921.9		
within	280	472.2		

*P - Punished or regular extinction
S - Starting procedure
D - Extinction days

Table 17 A summary of the analysis of variance applied to first segment (prepunishment) running speeds. The data were compiled according to the prepunishment extinction criterion.

Source*	df	ms	F	P
P	1	20664.2	2.47	
S	1	36879.5	4.42	< .05
D	7	5241.5	10.16	< .01
PS	1	71.8		
PD	7	920.0	1.78	
SD	7	538.6	1.04	
PSD	7	943.1	1.83	
error				
between	40	8335.0		
within	280	516.2		

*P - Punished or regular extinction
S - Starting procedure
D - Extinction days

Because the three-way interaction approached significance, and the *a priori* test using the three-way interaction contrast was reliable, the guillotine-door and drop-start data were reanalyzed separately. For the guillotine-door groups only the days effect proved reliable ($F = 3.77$, $p < .01$). The reanalysis for the drop-start groups, however, yielded significant effects of days ($F = 7.40$, $p < .01$) and of the days by punishment interaction ($F = 2.90$, $p < .01$). With the prepunishment criterion, therefore, self-punitive behavior was demonstrated by drop-start subjects, but not by those with the guillotine-door procedure.

D. *Trials to extinction*. Two-way analyses of variance were applied to the trials-to-extinction data compiled with the two extinction criteria. These data are shown in Table 18. With the traditional criterion of one failure to enter the goalbox only one effect proved reliable. Punished animals, regardless of starting procedure, completed significantly more extinction trials than nonpunished animals ($F = 4.57$, $p < .05$, df 1,40). The analysis of trials-to-extinction with the prepunishment criterion failed to reveal significant main effects of punishment, of starting procedure, or of their interaction.

E. *Correlation between acquisition speed and extinction performance*. As noted above, rats run with the drop-start procedure during extinction had reliably higher prepunishment speeds at the end of acquisition than those with the guillotine-door procedure. Because of the emphasis placed on prepunishment speeds during extinction, it was important to determine whether the extinction results could be explained by, or were confounded with, the inequality in the groups' acquisition speeds. Perhaps some relationship existed between running

Table 18 Mean trials to extinction as a function of extinction treatment and extinction criterion.

One failure to enter the goalbox

	Regular Extinction	Punished Extinction
Drop-start	21.6	26.3
Guillotine-door start	16.4	23.6

One failure to leave the prepunishment segment

	Regular Extinction	Punished Extinction
Drop-start	32.1	28.5
Guillotine-door start	26.8	24.6

speed at the end of acquisition and extinction performance. Analyses were run, therefore, for each group to determine whether there was a reliable correlation between acquisition speed and the degree to which the subjects slowed down during extinction. The highest correlation, however, was only .264, which did not differ significantly from zero ($t = .83$, $p = .43$).

Discussion

Strong evidence of self-punitive behavior was demonstrated in this experiment by subjects in both the drop-start and guillotine-door groups when the data were compiled using the traditional extinction criterion of one failure to enter the goalbox. Contrary to the results of Delprato and Meltzer (1974) and of Delude (1974), rats in the drop-start groups showed no reliable superiority over those in the guillotine-door groups. Punished rats run with both procedures maintained higher starting scores and faster prepunishment and postpunishment running speeds, and completed more extinction trials, than their nonpunished counterparts. When the data were recompiled according to the extinction criterion of one failure to leave the prepunishment zone, however, different relationships were revealed. With that criterion, reliable self-punitive responding was demonstrated only by drop-start subjects, results which were consistent with those of Delprato and Meltzer and of Delude.

The results of the experiment supported a number of hypotheses proposed, and answered several questions asked during the course of this set of experiments. First, self-punitive behavior was demonstrated by guillotine-door subjects when the data were compiled according to the traditional goalbox criterion. This outcome is consistent with that of the first experiment, and provided further evidence that subjects run with the guillotine-door procedure can indeed demonstrate self-punitive behavior. From the results of the first and third experiments, and similar outcomes reported by Martin and Melvin (1964), Martin and Moon (1968), Delude (1969), and Martin, Ragland, and Melvin (1970), there would seem to be no reason whatsoever to believe that self-punitive behavior can be obtained only with the drop procedure.

Second, the general lack of evidence for self-punitive behavior in the second experiment, combined with the strong self-punitive running in the third, further underscored the importance of the starting area exposure variable in demonstrations of self-punitive behavior. It appeared that even the short extra exposure to startbox cues given rats in the second experiment was sufficient to minimize self-punitive responding in that experiment. Hence, that variable was chosen as the most likely cause for the failure to observe self-punitive behavior in the second experiment. There were only two changes between the procedure used in the third experiment and that in the second experiment for 1-sec rats. These were the omission of the extra startbox exposure during acquisition and extinction, and the use of only 1-sec confinements, rather than both 1 and 16 sec confinements during escape acquisition training, for subjects in Experiment 3. Although it is somewhat hazardous to make between-experiment comparisons, it seems highly likely that the difference in the results of the two experiments can be attributed to the difference in exposure to startbox cues listed above. The most probable source of this difference in exposure was the deletion of the extra exposure to startbox cues during training and extinction.

Third, it was of great interest to note that from data derived by the traditional goalbox extinction criterion there was no evidence of a reliably greater self-punitive effect for subjects run with the drop-procedure than for those run with the guillotine-door procedure. Arithmetically, drop-start rats showed slightly better self-punitive behavior in terms of running speeds and starting scores, but guillotine-door subjects demonstrated somewhat greater punishment-produced resistance to extinction. Neither interaction, however, approached significance. These results are in direct contradiction to the position espoused by Delude which stresses the role of innate fear generated by the drop procedure. Such fear is said to combine with fear conditioned to startbox cues and to drive the subjects from the prepunishment zone into the shock. The results of this study contradict the idea that any innate fear generated by the drop contributed significantly to the production of self-punitive behavior or was necessary for the demonstration of the phenomenon.

A fourth interesting outcome of this experiment was that, when the data were recompiled according to the prepunishment criterion, punished subjects in the drop-start groups ran reliably faster than their non-punished counterparts, but the punished subjects in the guillotine-door groups did not. This result is contrary to that obtained with the goal-box extinction criterion. The empirical reason for this outcome is quite clear. The speeds of punished subjects in both groups did not appear to depend on the extinction criterion used. When punished rats stopped running they not only no longer entered the goalbox but also no longer left the prepunishment segment of the alley. For subjects in the nonpunished groups, however, the choice of extinction criterion made a great difference. Most nonpunished subjects met the goalbox extinction criterion during the eight days of regular extinction, but few met the prepunishment criterion. Their running speeds, compiled according to the goalbox extinction criterion, approached the arbitrary minimum of 4.1 cm/sec. Running speeds with the prepunishment criterion, on the other hand, quickly leveled off at about 45 cm/sec, for those in the guillotine-door groups, or reached that level by the end of extinction for those in the drop-start groups. Thus, the large differences observed between punished and nonpunished subjects in both starting procedure groups with the traditional extinction criterion, were substantially reduced by the use of the prepunishment criterion. Although the speed differences were in a direction indicating self-punitive behavior for both drop-start and guillotine-door subjects, prepunishment speeds with this criterion revealed reliable self-punitive running for only those run with the drop procedure.

It remains to be explained why the nonpunished subjects maintained the relatively high speeds during extinction which reduced the difference between punished and nonpunished subjects. One possibility is that nonpunished subjects, after many regular extinction trials, have a high base rate of activity. This is consistent with the experimenter's observation that after several days of extinction, nonpunished subjects wandered or raced back and forth in the alley when they were released from the startbox at the beginning of each trial. Such a base rate of responding has also been noted by others (Brown, 1974, Anderson, 1975). In addition, the same effect was noted in the first two experiments, although it was not so marked in the second, and much less evident in the first.

Finally, in this experiment, as in the second, the drop procedure led to higher running speeds, overall, than the guillotine-door procedure. As previously mentioned, this might have been due to some energizing effect of the drop itself (Delude, 1974) or the more salient features of stimuli associated with the drop (Brown, 1969). In either event, this effect did not reliably affect the level of self-punitive responding in terms of any of the four dependent variables when the data were compiled according to the goalbox extinction criterion, but did have an effect when the prepunishment criterion was used.

This apparent contradiction may be reconciled, to some extent, if we set aside our statistical analyses for a moment and look at the data plotted in Figures 23 and 24. With the goalbox criterion (Figure 23) punished subjects in the drop groups were faster than those in the guillotine-door groups, and nonpunished subjects in the drop groups were faster than those in the guillotine-door groups. Differences between punished and nonpunished subjects in both groups were quite large in both cases and led to the demonstration of self-punitive running with both procedures. When the prepunishment criterion was used (Figure 24) only the drop-start procedure led to reliable self-punitive behavior. The superiority of the punished subjects in the drop-start group over those in the guillotine-door group was no greater with one extinction criterion than the other. Instead, because of the elevated level of responding by nonpunished subjects, only about 20 cm/sec separated punished and nonpunished subjects in the guillotine-door groups over the last half of the extinction trials, while nearly 30 cm/sec separated the drop-start groups. While the former difference was not great enough to be statistically significant, the latter was thus leading to the results we obtained.

Probably the best statement that can be made at this point is that with the goalbox criterion there appears to be no doubt that strong self-punitive behavior was obtained with both procedures. With the prepunishment criterion the drop-start subjects showed marked and reliable self-punitive responding, while guillotine-door subjects demonstrated visually apparent, but statistically unreliable punishment-produced response facilitation. It is easy to speculate that a clever statistician could delve into the data and come up with one, or perhaps several tests showing that these differences were really "statistically significant." It is not clear, however, that such a demonstration would add much to our understanding of the phenomenon.

In summary, the self-punitive behavior of subjects run with the drop-starting procedure, and of those run with the guillotine-door procedure, were compared in this experiment. When the traditional extinction criterion of one failure to enter the goalbox was used, subjects run with both procedures demonstrated strong self-punitive behavior. There was no difference in the degree of self-punitive responding shown by those in the drop and guillotine-door groups. This was consistent with expectations derived from the motivational-associative Mowrer-Brown model, but not with Delude's model which stressed the superiority of the drop procedure. When the data were recompiled according to the extinction criterion of one failure to leave the prepunishment zone, however, only drop-start subjects showed reliable self-punitive running. This result was in accordance with the predictions from Delude's hypothesis, but could also be explained by the Mowrer-Brown model. The experiment highlighted the importance of three factors, startbox exposure, extinction criterion, and starting procedure, in demonstrations of self-punitive behavior.

SUMMARY, GENERAL DISCUSSION, AND CLOSING COMMENTS

The three experiments described above have provided new information bearing on the conditions under which self-punitive behavior occurs, and on the interpretation of existing experiments. The primary aim of the three experiments was to evaluate the relative effectiveness of two different starting procedures and two durations of starting area confinement for the production of self-punitive behavior. It was hoped that the results would be of assistance in the assessment of recent interpretations of self-punitive behavior based on experiments in which these factors were explicitly or implicitly manipulated.

In three recent experiments, by Delude (1973, 1974) and Delprato and Meltzer (1974), the drop and guillotine-door starting procedures were compared. In each of these studies subjects run with the drop-procedure demonstrated reliable self-punitive behavior, while those run with the guillotine-door procedure did not. From his data Delude concluded that self-punitive behavior can be demonstrated only under certain laboratory conditions involving the use of a starting procedure possessing unconditioned aversive properties, such as the drop procedure which supposedly has innate fear-arousing properties. It could not, therefore, serve as a <u>general</u> model of the effects of punishment on all aversively motivated responding. Instead, it is limited to situations wherein substantial unconditioned aversive stimulation occurs just prior to, and perhaps elicits, the punished response.

In reviewing the reports of Delude, and of Delprato and Meltzer, it was noted that their experiments appeared to be confounded. Subjects in the drop groups were not exposed to the cues of the starting area before each trial but subjects in the guillotine-door groups were. Either a cognitive discrimination hypothesis or a motivational-associative hypothesis of the Mowrer-Brown type would predict that subjects given long exposures to starting area cues would demonstrate less self-punitive behavior than those with shorter exposures. Thus, their results might have been attributable not to the drop or guillotine-door procedures, _per se_, but rather to the short exposure to starting area cues associated with the drop procedure and the long exposure associated with the guillotine-door procedure. A second consideration, of methodological significance, was their use of an extinction criterion based on behavior in the preshock segments of their alleys, rather than the traditional extinction criterion based on failure to enter the goalbox. Although there is only one published report in which these extinction criteria were compared (Delude, 1969) numerous authors have commented on the possible importance of this factor.

In the first of the three experiments, which was run entirely with the guillotine-door procedure, rats exposed to the starting area cues for 16 sec prior to each trial did not demonstrate self-punitive behavior while those exposed for only 1 sec showed strong self-punitive running. Interestingly, this relationship was not a function of the extinction criterion used. In addition, these results did not depend on whether the subjects were run with a procedure wherein the temporal arrangement of handling was confounded with confinement duration (the "modified-conventional procedure") or wherein there was no confounding (the "controlled" handling procedure).

In Experiment 2 the drop and guillotine-door procedures were compared using an experimental design wherein half the subjects run with each procedure were given 16 sec exposure to starting area cues prior to each trial, and half were given only 1 sec exposure. The somewhat puzzling result was that although drop-start subjects overall showed better extinction performance than those with the guillotine-door procedure, those in neither group demonstrated reliable self-punitive running, regardless of confinement time. Instead, they all seemed to behave as did the rats in the 16-sec groups in the first experiment.

It was noted that in the second experiment a control procedure was employed in which the subjects of the 1-sec groups were briefly exposed to the starting area cues prior to each trial, and were then returned to their carrying cage. It seemed possible that even this short extra exposure to starting area cues might have sufficed to attenuate their self-punitive running significantly. In the third experiment, therefore, additional 1-sec groups were run, but without the extra exposure to starting area cues. The subjects in both the drop and guillotine-door groups demonstrated strong self-punitive behavior when the traditional goalbox extinction criterion was used. When the prepunishment extinction criterion was utilized, however, punished rats in both groups ran arithmetically faster than their nonpunished counterparts, but only the drop-start subjects showed statistically reliable self-punitive running.

From these results it appears that several of the factors studied are of significance in investigations of self-punitive behavior.

First, the duration of exposure to starting area cues seems to be of paramount importance. In neither Experiment 1 nor Experiment 2 did punished subjects with the 16 sec exposure to starting area cues run reliably faster or longer than nonpunished subjects. In addition, it is noteworthy that even the relatively short extra exposure to starting area cues given 1-sec subjects in Experiment 2 seemed to interfere with self-punitive behavior. Second, while the drop procedure led to better overall extinction performance in Experiments 2 and 3, it was not sufficient to lead to self-punitive running in the second experiment where the extra exposure was given. Only in the third experiment, where short starting area exposures were used exclusively, did the drop procedure lead to better self-punitive running, and then only when the data were compiled according to the prepunishment extinction criterion. With the traditional criterion there were no reliable differences between the degree of self-punitive running shown by subjects in the guillotine-door groups and those in the drop-start groups.

From these experiments it would seem that the results of the studies by Delude, and Delprato and Meltzer, were attributable, in part, to the starting area confinements they used, and possibly to their use of a prepunishment extinction criterion. In either event, it would seem that rather than accepting Delude's proposition, we are probably better advised to follow the more moderate course offered by the motivational-associative analysis of self-punitive behavior. With such an analysis we can readily account for the fact that drop-start subjects run better, overall, during extinction. The drop procedure may have very salient stimulus properties to which fear and locomotor responding can be conditioned, or may have some intrinsic motivational properties. Any superior self-punitive behavior shown by drop-start subjects over guillotine-door subjects could be attributed to these mechanisms because the motivational-associative interpretation can rely on any source of motivation, and any stimuli to which running can be conditioned. As the first and third experiments demonstrated, however, the drop procedure certainly is not necessary for the demonstration of self-punitive running as Delude's position would suggest.

Comments on the traditional goalbox extinction criterion and the newer prepunishment extinction criterion would seem also to be in order. It is of some importance that the goalbox criterion seems to have the advantage of frequency of use. Thus, results of any additional experiments using the goalbox extinction criterion are more easily interpreted in the light of existing literature.

In addition, use of the goalbox criterion seems to favor the demonstration of self-punitive running. Punished subjects which do leave the startbox and traverse the punishment zone are usually running rapidly as they leave the shock and speed into the goal area. Nonpunished subjects, without this "boost" seem more hesitant to enter. With the goalbox criterion emphasis is placed on both starting and completing the response sequence, a choice which could favor punished subjects.

When the prepunishment criterion is used, on the other hand, nonpunished subjects rarely "extinguish." The reason for this seems clear. After many extinction trials, for nonpunished subjects, little or no fear should be elicited by alley cues. Thus, one might expect a good deal of exploratory behavior or operant level activity, at least enough so that they would be unlikely to remain in the prepunishment segment long enough to meet the extinction criterion. For punished subjects, however, a large number of punished extinction trials, incorporating as they do a differential conditioning paradigm (discussed in detail on p. 64-67), would lead to a gradient such that the most fear would be elicited by cues immediately preceding the shock zone, and substantially less by cues at the startbox. If conditions were not instituted to prevent extinction of fear to starting area cues (such as randomly varying the location of shock or locating the shock immediately adjacent to the starting area), punished subjects would be expected to extinguish eventually. It would seem, therefore, that the use of the prepunishment criterion would favor the demonstration of punishment-produced response suppression, particularly if a large number of extinction trials were given.

While it is not hard to speculate on the consequences of using one extinction criterion or the other, relatively few experiments have been conducted in which the results have actually been compared to confirm or contradict these speculations. In addition, lacking an adequate body of empirical data, we are uncertain what the relative merits of these criteria might be in terms of the meaningfulness of the behavioral laws generated. It would seem that one practical solution, until such information is available, might be to use both criteria, as in the experiments above, and consider the results derived from each.

Finally, we might ask what larger significance the results of the experiments have. Certainly, it appears that the self-punitive behavior paradigm is not ready to be placed on a shelf and stored away as merely a curiosity. The validity of the self-punitive effect, under a wide range of conditions (even a most severe test such as in first experiment) would seem to assure it a prominent place in general learning theory. In that context it provides a fine example of a counter-intuitive phenomenon which can be predicted by our knowledge of the laws of learning and motivation.

Going a step further, a number of authors (Mowrer, 1947; Brown, 1965; Melvin, 1971; Fago, 1971) have suggested that there exists a relationship between laboratory demonstrations of self-punitive behavior in rats and certain human responses to aversive stimulation, particularly "vicious-circle" behavior as described by Horney (1937). Certainly, if we are willing to attribute any cross-species generality to our laws of behavior, we should seriously consider this possibility. Although there appear to be only a few reports of traditional laboratory work on self-punitive behavior conducted from the viewpoint of the clinical psychologist, it would seem that the paradigm holds promise for furthering the understanding of both the therapist and the learning theorist.

REFERENCES

Anderson, D. C. Personal communication, 1975.

Anson, J. E., Bender, L., & Melvin, K. B. Sources of reinforcement of self-punitive behavior. Journal of Comparative and Physiological Psychology, 1969, 67, 376-380.

Babb, H. & Hom, H. L., Jr. Self-punitive responding by goal-shocked rats. Journal of Comparative and Physiological Psychology, 1971, 77, 482-488.

Beecroft, R. S. Near-goal punishment of avoidance running. Psychonomic Science, 1967, 8, 109-110.

Beecroft, R. S., & Bouska, S. A. Learning self-punitive running. Psychonomic Science, 1967, 8, 107-108.

Beecroft, R. S., Bouska, S. A., & Fisher, B. G. Punishment intensity and self-punitive behavior. Psychonomic Science, 1967, 8, 351-352.

Beecroft, R. S., & Brown, J. S. Punishment following escape and avoidance training. Psychonomic Science, 1967, 8, 349-350.

Beecroft, R. S., & Fisher, B. G. Avoidance punishment and self-punitive behavior. Psychonomic Science, 1969, 15, 243-244.

Beecroft, R. S., Fisher, B. G., & Bouska, S. A. Punishment continuity and self-punitive behavior. Psychonomic Science, 1967, 9, 127-128.

Bender, L. Secondary punishment and self-punitive avoidance behavior. Journal of Comparative and Physiological Psychology, 1969, 69, 261-266.

Bender, L., & Melvin, K. B. Self-punitive behavior: Effects of percentage of punishment on extinction of escape and avoidance responses. Psychonomic Science, 1967, 9, 573-574.

Brown, J. S. A behavioral analysis of masochism. Journal of Experimental Research in Personality, 1965, 1, 65-70.

Brown, J. S. Factors influencing self-punitive locomotor behavior. In B. A. Campbell and R. M. Church (Eds.), Punishment and Aversive Behavior. New York: Appleton-Century-Crofts, 1969.

Brown, J. S. Self-punitive behavior with a distinctively-marked punishment zone. Psychonomic Science, 1970, 21, 161-163.

Brown, J. S. Personal communication, 1974.

Brown, J. S., Anderson, R. C., & Weiss, C. G. Self-punitive behavior under conditions of massed practice. Journal of Comparative and Physiological Psychology, 1965, 60, 451-453.

Brown, J. S., Beier, E. M., & Lewis, R. W. Punishment-zone distinctiveness and self-punitive locomotor behavior in the rat. Journal of Comparative and Physiological Psychology, 1971, 77, 513-520.

Brown, J. S., Horsfall, R. S., & Van Bruggen, P. J. Self-punitive behavior as a function of the position of shock in the behavior sequence. Unpublished study cited in Brown, 1969.

Brown, J. S., Martin, R. C., & Morrow, M. W. Self-punitive behavior in the rat: Facilitative effects of punishment on resistance to extinction. Journal of Comparative and Physiological Psychology, 1964, 57, 127-133.

Byrd, L. D. Responding in the cat maintained under response-independent electric shock and response-produced electric shock. Journal of the Experimental Analysis of Behavior, 1969, 12, 1-10.

Campbell, B. A., Smith, N. F., & Misanin, J. R. Effects of punishment on extinction of avoidance behavior: Avoidance-avoidance conflict or vicious circle behavior? Journal of Comparative and Physiological Psychology, 1966, 62, 495-498.

Church, R. M. The varied effects of punishment on behavior. Psychological Review, 1963, 70, 369-402.

Crowell, C. R. Personal communication, 1974.

Crowell, C. R., Brown, J. S., & Lewis, R. W. Self-punitive behavior in the rat during successive-discrimination "extinction" trials. Psychonomic Science, 1972, 27, 131-135.

Cunningham, C. L., Brown, J. S., & Roberts, S. Startbox-goalbox confinement duration as a determinant of self-punitive behavior. Manuscript submitted for publication, 1975.

Delprato, D. J., & Denny, M. R. Punishment and the length of non-shock confinement during the extinction of avoidance. Canadian Journal of Psychology, 1968, 22, 456-464.

Delprato, D. J., & Meltzer, R. J. Type of startbox and goalbox distinctiveness in self-punitive running of rats. Journal of Comparative and Physiological Psychology, 1974, 87, 548-554.

Delude, L. A. The vicious circle phenomenon: A result of measurement artifact. Journal of Comparative and Physiological Psychology, 1969, 69, 246-252.

Delude, L. A. Factors affecting the strength of the vicious circle phenomenon. Psychological Record, 1973, 23, 467-476.

Delude, L. A. Starting procedures and the vicious circle phenomenon. Canadian Journal of Psychology, 1974, 28, 125-130.

Dreyer, P., & Renner, K. E. Self-punitive behavior-Masochism or confusion? Psychological Review, 1971, 78, 333-337.

Eaton, N. K. Self-punitive locomotor behavior as a function of fixed or varied shock zone location. M. A. Thesis, University of Iowa, 1972.

Eaton, N. K. The effect of punishment upon the extinction of locomotor avoidance behavior in a two-way apparatus. Unpublished manuscript, University of Oregon Medical School, 1974a.

Eaton, N. K. The effect of pretrial CS onset and acquisition criterion severity upon the extinction of an avoidance response under punished or non-punished conditions. Unpublished manuscript, University of Oregon Medical School, 1974b.

Eaton, N. K. & Crowell, C. R. The role of explicit CS presentation upon the acquisition of an escape response and the maintenance of self-punitive running. Unpublished manuscript, University of Oregon Medical School, 1974.

Fago, A. E. P. Therapy analogues in a self-punitive situation (Doctoral dissertation, University of Pittsburgh, 1971). Dissertation Abstracts International, 1971, 32(6-B), 3632-3633. (University Microfilms No. 72-1109.

Fitzgerald, R. D. & Walloch, R. A. Resistance to extinction of a punished wheel-turning escape response in rats. Journal of Comparative and Physiological Psychology, 1969, 68, 254-261.

Galvani, P. F. Self-punitive behavior as a function of number of prior fear-conditioning trials. Journal of Comparative and Physiological Psychology, 1969, 68, 359-363.

Gwinn, G. T. The effects of punishment on acts motivated by fear. Journal of Experimental Psychology, 1949, 39, 260-269.

Horney, K. The neurotic personality in our time. New York: Norton, 1937.

Imada, H. The effects of punishment on avoidance behavior. Japanese Psychological Research, 1959, 27-38.

Klare, W. F. Conditioned fear and postshock emotionality in vicious circle behavior of rats. Journal of Comparative and Physiological Psychology, 1974, 87, 361-372.

Kruger, B. A. Self-punitive running in the rat following start-box fear conditioning. Journal of Comparative and Physiological Psychology, 1974, 87, 555-562.

Latane, B. Gregariousness and fear in lab rats. Journal of Experimental Social Psychology, 1968, 5, 61-69.

Latane, E. & Glass, D. C. Social and non-social attraction in rats. Journal of Personality and Social Psychology, 1969, 9, 142-146.

Martin, R. C. Self-punitive behavior: One way to stop it. Psychonomic Science, 1969, 14, 25-26.

Martin, R. C. Personal communication, 1972.

Martin, R. C., Deemer, B., & McArdle, N. The effects of chlorpromazine on self-punitive behavior. Psychonomic Science, 1971, 23, 339-340.

Martin, R. C. & Melvin, K. B. Vicious circle behavior as a function of delay of punishment. Psychonomic Science, 1964, 1, 415-416.

Martin, R. C. & Melvin, K. B. Punishment-induced facilitation: Comments and analysis. Psychonomic Science, 1966, 5, 269-270.

Martin, R. C., Ragland, E., & Melvin, K. B. Self-punitive locomotor behavior in the Mongolian gerbil. Psychonomic Science, 1970, 20, 183-184.

McKearney, J. W. Maintenance of responding under a fixed-interval schedule of electric shock-presentation. Science, 1968, 160, 1249-1251.

McKearney, J. W. Fixed-interval schedules of electric shock presentation: Extinction and recovery of performance under different shock intensities and fixed-interval durations. Journal of the Experimental Analysis of Behavior, 1969, 12, 301-313.

Melvin, K. B. Escape learning and "vicious circle" behavior as a function of percentage of reinforcement. Journal of Comparative and Physiological Psychology, 1964, 58, 248-251.

Melvin, K. B. Vicious circle behavior. In H. D. Kimmel (Ed.), Experimental Psychopathology: Recent research and theory. New York: Academic Press, 1971.

Melvin, K. B., Athey, G. I., Jr., & Heasley, F. H. Effects of duration and delay of shock on self-punitive behavior in the rat. Psychological Reports, 1965, 17, 107-112.

Melvin, K. B. & Bender, L. Self-punitive avoidance behavior: Effects of changes in punishment intensity. Psychological Record, 1968, 18, 29-34.

Melvin, K. B. & Martin, R. C. Facilitative effects of two modes of punishment on resistance to extinction. Journal of Comparative and Physiological Psychology, 1966, 62, 491-494.

Melvin, K. B., Martin, R. C., & Parsons, G. Delayed extinction of escape responses: A parametric study. Psychonomic Science, 1965, 2, 247-248.

Melvin, K. B. & Stenmark, D. L. Facilitative effects of punishment on the establishment of a fear motivated response. Journal of Comparative and Physiological Psychology, 1968, 65, 517-519.

Melvin, K. B. & Smith, F. H. Self-punitive avoidance behavior in the rat. Journal of Comparative and Physiological Psychology, 1967, 63, 533-535.

Mowrer, O. H. On the dual nature of learning: A reinterpretation of "conditioning" and "problem solving." Harvard Educational Review, 1947, 17, 102-148.

Mowrer, O. H. Learning theory and behavior. New York: Wiley, 1960.

Moyer, K. E. A study of some of the variables of which fixation is a function. Journal of Genetic Psychology, 1955, 86, 3-31.

O'Neil, H. F., Skeen, L. C., & Ryan, F. J. Prevention of vicious circle behavior. Journal of Comparative and Physiological Psychology, 1970, 70, 281-285.

Rollins, P. J. & Melvin, K. B. Effects of a punitive noise on self-punitive running established with shock. Psychonomic Science, 1970, 21, 313-314.

Sandler, J., Davidson, R. S., & Holzschuh, R. D. Effects of increasing punishment frequency on Sidman avoidance behavior. Psychonomic Science, 1966, 5, 103-104.

Seligman, M. E. P. & Campbell, B. A. Effect of intensity and duration of punishment on extinction of an avoidance response. Journal of Comparative and Physiological Psychology, 1965, 59, 295-297.

Seward, J. P., King, R. M., Chow, T., & Shiflett, S.C. Persistence of punished escape responses. Journal of Comparative and Physiological Psychology, 1965, 60, 265-268.

Seward, J. P., & Raskin, D. C. The role of fear in aversive behavior. Journal of Comparative and Physiological Psychology, 1960, 53, 328-335.

Seigal, P. S., Melvin, K. B., & Wagner, J. D. Vicious circle behavior in the rat: Measurement problems visited again. Journal of Comparative and Physiological Psychology, 1971, 70, 311-315.

Smith, N. F., Misanin, J. R., & Campbell, B. A. Effect of punishment on extinction of an avoidance response: Facilitation or inhibition? Psychonomic Science, 1966, 4, 271-272.

Smith, N. F., Misanin, J. R., & Campbell, B. A. Effect of punishment: Facilitation or inhibition? A reply to Martin and Melvin. Psychonomic Science, 1966a, 5, 363-364.

Solomon, R. L., Kamin, L. J., & Wynne, L. C. Traumatic avoidance learning: The outcomes of several extinction procedures with dogs. Journal of Abnormal and Social Psychology, 1953, 48, 291-302.

Stenmark, D. L. & Melvin, K. B. Facilitative effects of punishment on the establishment of a new response. Paper presented at the meetings of the Southeastern Psychological Association, New Orleans, 1966.

Stretch, R., Orloff, E. R., & Dalrymple, S. D. Maintenance of responding by fixed-interval schedule of electric shock presentation in squirrel monkeys. Science, 1968, 162, 583-585.

Tinsley, J. B. & Renner, K. E. Disrupting self-punitive persistence. Paper presented at the meetings of the Midwestern Psychological Association, Chicago, 1975.

Walker, J., Williams, S., & Martin, R. C. The effects of social interaction upon persistence of self-punitive behavior. Bulletin of the Psychonomic Society, 1974, 2, 423-425.

Wells, M. G. & Merrill, H. K. Self-punitive behavior in the rat: A free-operant demonstration. Psychonomic Science, 1969, 15, 7-8.

Whiteis, U. E. Punishment's influence on fear and avoidance. Harvard Educational Review, 1956, 26, 360-373.

Williams, J. T. Factors influencing the vicious circle phenomenon. Psychological Reports, 1967, 21, 633-642.

APPENDICES

APPENDIX A

A review of the literature on self-punitive locomotor behavior

Introduction

Since the initial report by Mowrer (1947) that the application of punishment during the extinction of an aversively motivated response can have "paradoxical" facilitating effects on extinction responding, and his insightful interpretation of this phenomenon, there have been more than 50 published reports dealing with this "self-punitive behavior." In the following pages these studies are reviewed in detail. Experiments in which the effect was obtained, as well as those in which either no facilitation was evidenced, or a suppressive effect was reported, are included. Where possible an attempt has been made to provide an explanation of the authors' results in light of our current knowledge of the phenomena. The studies are divided into two groups, comprising those which antedate and those which occurred during or followed, 1964, the year in which the current boom in self-punitive locomotor behavior studies began. A chronological order has been chosen in order to provide the reader with a perspective on the historical development of research in this area. A summary of the important variables affecting self-punitive locomotor behavior and of contemporary theories of these "paradoxical" effects of punishment are provided in the introduction.

Early Studies

Gwinn (1949) reported the first systematic study of the effects of punishment during the extinction of an aversively motivated response. In his experiment, Gwinn trained rats to escape shock in an eight-section circular runway. His subjects received massed trials with a

10-sec ITI (intertrial-interval). Each trial was initiated by dropping the rats by hand into the first segment of the alley. The animals escaped 60 v (through 10K ohms) shock by running to the eighth section and jumping up into an escape cage. Following 18 acquisition trials the subjects were extinguished. Four punished-extinction groups of 4 rats each were shocked in visually distinctive 6th and 7th sections of the alley and 8 rats were given no-shock regular extinction trials. Rats in two punished groups were shocked on every trial during extinction, those in one of these groups at an intensity of 120 v, and those in the other at 60 v. Rats in the second pair of groups were shocked on a third of the extinction trials, again, those in one of the groups at 120 v and those in the other at 60 v. Extinction continued until the rats met the extinction criterion of failing to enter the escape cage within 10 sec. Punished rats ran faster in the preshock segment than did the nonpunished rats, and those punished with shock of the higher intensity ran faster than those punished with shock of the lower intensity. The punished rats, overall, ran more trials during extinction than the nonpunished rats, and rats punished with the stronger shock ran more extinction trials than those punished with the weak shock. The percentage of shock was not a significant factor in determining either running speed or trials to extinction. Gwinn also noted that for rats given partial-punishment, preshock running speeds were reliably slower on trials immediately following, than on trials immediately preceding, shock. Gwinn interpreted these results as suggesting that punishment does not necessarily suppress punished responses, and added that these results are consistent with, and can be interpreted by, an expansion of Mowrer's (1947) conditioned fear theory.

In an interesting study with dogs, Solomon, Kamin, and Wynne (1953) demonstrated facilitative effects of punishment on the performance of a shuttle-avoidance response during extinction. Their subjects, dogs, were given shuttle-avoidance acquisition trials, 10 per day, with an ITI of 3 min, until they completed 10 successive avoidances. The CS-US interval, the time from the presentation of the CS (the conditioned stimulus) until the presentation of the aversive US (unconditioned stimulus) was 10 sec for some dogs and 20 sec for others. Following the 10th successive avoidance, extinction conditions were instituted. After 10 regular extinction trials (or 200 for some dogs) punished extinction began. A 3-sec shock was presented only if the dog made the shuttle response. Dogs treated in this manner displayed marked resistance to extinction, and performed under punished extinction conditions with both shorter response latencies and increased vigor than under regular extinction. The authors suggested that the application of shock following each response served to recondition fear through forward pairings of the avoidance CS and the shock US. Fear then, elicited by the CS, served to facilitate performance during extinction. This theory, of course, is like Mowrer's conditioned fear interpretation of self-punitive locomotor behavior.

Moyer (1955) studied the effects of punishment on the extinction of avoidance rather than escape behavior as Gwinn had done. His apparatus consisted of a rectangular box with a grid floor, each half of which could be independently charged. A small goalbox was located at the end of the box opposite that where the rats were placed at the beginning of each trial. During acquisition a subject could avoid shock by leaving the starting side and entering the goalbox within 10 sec, the "avoidance interval." Each rat was allowed to remain in the goalbox for 10 sec between trials. Following 110 avoidance acquisition trials, one group of 10 rats was given no-shock regular extinction while the second group of 10 rats received punished extinction. For these rats the half of the grid between the starting side and the goalbox was electrified. The extinction criterion for punished rats was failure to enter the shock side of the apparatus within 5 min. Unpunished rats, however, were allowed a maximum of 5 min to enter the goalbox and remain there for 10 sec. Those that failed to do so were considered to have extinguished. Moyer reported that punished rats required fewer trials to meet their extinction criterion than did the unpunished rats to meet theirs. With a 10-sec rather than 5-min criterion, however, the punished rats averaged nearly twice as many trials to extinction as did the nonpunished rats, but the difference did not reach acceptable levels of reliability.

In a second experiment Moyer trained rats to escape shock in the same apparatus, placing them in the starting side for 10 sec and then simultaneously opening the goalbox guillotine-door and energizing the entire grid. Following 10 such trials punished extinction conditions were instituted for one group of rats and regular extinction conditions for the second group. Each rat was given 40 trials per day until it met the extinction criterion of failure to enter the goalbox within 2 min. Although the mean number of extinction trials for the punished rats was 105, and for the nonpunished rats was only 41, a Mann-Whitney test indicated that this difference was not reliable. Running speeds were also analyzed but failed to yield significant differences between groups except for the last 10th of Vincentized latency scores, where punished rats were faster than unpunished rats. Moyer interpreted these results as providing no evidence to support the hypothesis that shock during extinction of an anxiety-motivated response facilitates such a response under the conditions he used. It seems likely, however, that his use of a goal area that was similar to the area where shock was presented, and the rather long 5-min extinction criterion, could have significantly affected his results.

Whiteis (1956) reported a study in which rats were first given 50 avoidance trials with an avoidance interval of 10 sec. Following this acquisition training, regular extinction conditions were introduced for one group of 6 rats and punished extinction conditions were employed for a second group of 6 rats. For punished rats, the section of the alley just in front of the goal was electrified on every trial. Although the details of the experiment were not given, Whiteis reported that the punished rats speeded up during extinction whereas rats given regular extinction slowed down. In addition, punished rats completed more extinction trials than did nonpunished rats and seemed to extinguish more suddenly. He noted that these results were consistent with both Mowrer's conditioned anxiety or fear interpretation, and a conflict-induced frustration interpretation wherein conflict generated by the simultaneous elicitation of incompatible responses induces drive increments that magnify the dominant response of forward locomotion.

In 1959 Imada reported an experiment in which a 1-sec shock was presented on the goal side of a dual-compartment shuttlebox of the Miller-Mower type during the extinction of a shuttle avoidance response.

Each side of the box was painted gray, had a grid floor, and was separated from the other by a 7-cm high barrier and guillotine door. One min before each trial the rats were placed in the starting side of the apparatus. When the trial began the guillotine door was raised, the visual CS came on, and, 10 sec later, the grid was energized with 200 v if the rat had failed to make the shuttle response. Ten trials per day were given with a 3 min ITI (intertrial-interval) until the rats had reached the acquisition criterion of 10 successive avoidances. Following acquisition 10 rats were assigned to the regular extinction group and 12 rats each to five punished groups. The punished groups differed only in the intensity of punishment delivered when they made the barrier jumping response. These intensities were 118, 153, 200, 260, or 340 v. An analysis of the results indicated that the punished groups completed significantly fewer trials than did the regular extinction group before meeting the extinction criterion of 5 successive failures to make the shuttle response within 2 min. Although both punished and nonpunished rats demonstrated speed increases on the first 10 extinction trials, these increases were smaller for punished than nonpunished rats. Within the punished groups, however, the greater the punishment intensity the more trials needed to reach the extinction criterion and the greater the speed increases at the beginning of extinction. Imada also noted the vigor of the shuttle response and reported that the punished rats jumped the barrier with greater vigor than did the nonpunished rats. Finally, he reported that rats receiving the stronger punishment intensities had greater increases in jumping vigor during the first 10 extinction trials than did rats administered weaker punishment. He interpreted his results as demonstrating both inhibitory and facilitative effects of punishment, depending upon the dependent measure considered.

Seward and Raskin (1960) also reported a series of experiments dealing with the effects of punishment administered during the extinction of an aversively motivated response, and following exploration-only trials on which no aversive stimulation had been presented. They used a gray, grid-floored alleyway divided into three sections by guillotine doors. In the first experiment, 14 rats, which had previously been given only 15 min to explore the apparatus, were placed into the alley at the starting end. The shock, delivered in the middle section of the alley, was 190 v through 150K ohms. If a rat in the punished group reached the center of the middle section of the alley the entire middle section was electrified. These rats could escape the punishment either by returning to the starting area or running forward to the goal area. In addition to the 14 punished rats, 4 controls, which received no punishment, were also run. The authors reported that by the second trial only 3 of the 14 punished rats crossed the middle section to enter the goal area, and that none of these rats ran to the goal section more than three times. All non-punished rats, on the other hand, ran into the goal section on the second trial. In the second experiment, again without escape or avoidance training prior to punishment, the end segment was made distinctive. The walls were covered with black cardboard while those of the alley and starting area remained gray. Eight punished and two nonpunished rats were given treatment analogous to that given in

Experiment 1. The primary finding in Experiment 2 was an increase in the reluctance of the rats in both groups to enter the black-walled goal segment. On Trial 2 none of the punished rats entered the end segment. Specific results for the nonpunished rats were not reported. In the third experiment the procedures and alley were similar to those of the first experiment. The only difference was that the shock intensity for the punished rats was reduced to 125 v. By the third trial only 1 of the 8 punished rats entered the goal section while both of the nonpunished rats did.

In a fourth experiment a procedure more like Gwinn's was used. Rats were first given 20 massed (30 sec ITI) escape trials on which 190 v was presented in the gray starting and middle section but not in the gray end section. Fifteen rats were assigned to each of three groups, one group was given regular extinction, one group was punished on every trial in the middle section, and a third group was punished on 50% of the trials in the middle section. The rats were run until they failed to reach the center of the middle section within 10 sec on two successive trials. Punished subjects required fewer trials to extinguish than nonpunished rats, but had faster prepunishment speeds on pre-criterion trials. In this study, as in Whiteis', punished rats met the extinction criterion suddenly while nonpunished rats slowed down progressively. Experiment 5 was identical to Experiment 4 with the exception that the rats received avoidance training rather than escape training. The CS-US interval was 5 sec on the first 10 acquisition trials and 2.5 sec on the last 5. Although punished rats completed more trials during extinction than did nonpunished rats, this difference was not statistically reliable. Preshock running speeds on the last five trials prior to extinction also did not differ between groups. Seward and Raskin suggested that the differences between their results and those reported by Gwinn might have been due to the high shock intensities they used. The very intense 190 v shock could have elicited freezing which might have competed with forward locomotion. Such freezing might not occur with lower intensity shock. We should note, in addition, that the conditions in Seward and Raskin's experiment were quite unlike those in Gwinn's experiment in several other respects. The safe area at the end of the alley was identical to the shock segment and the starting area in Seward and Raskin's experiment. The similarity of the shock segment to the starting and end segments might allow fear to generalize to both those sections. Rather than running to a goal area with cues that do not elicit fear and where fear reduction and thus reinforcement could occur, Seward and Raskin's rats ran to a goal area with presumably fear-eliciting cues.

Recent Studies

In 1964 Brown, Martin, and Morrow published a report of two studies that has received a great deal of attention. The apparatus used in both studies was a gray 6-ft alleyway with a grid floor. The bi-level starting segment was also painted gray and was composed of two chambers, one above the other. An upper compartment was separated by a trapdoor-floor from the lower grid-floored compartment. The goal area, however, was highly dissimilar to the alley and starting segment; it was painted black, had a smooth floor, and was considerably wider.

In the first experiment 54 rats were trained to escape shock of gradually increasing intensity (up to 75 v through 10 K ohms) for four days, 10 trials per day. On each trial the subject was placed into the upper compartment of the startbox. Several seconds later a blinking light CS began to flash followed, after 3 sec, by a whirring noise. After two more seconds the trapdoor floor was released and the rat dropped into the lower starting chamber, beginning the trial. During escape trials only the lower starting chamber and alleyway grids were charged. When the subject escaped into the goalbox a guillotine-door was lowered to prevent the rat's returning to the alleyway. Thirty sec later the subject was removed to the carrying cage where it remained for the ITI of 5 to 7 min. Beginning on the fifth day the rats were randomly assigned to one of three groups of 18. One group (regular extinction) encountered no shock in either the startbox or alley, one was punished on every trial with 60 v present in only the last two feet of the alley, and one was punished with shock in the entire alleyway, but not in the starting section. Each rat was given ten trials per day until it failed to enter the goalbox within 60 sec or until it had completed 60 trials. Running speeds in the 6-ft alley were slightly (but not reliably) higher for punished rats than non-punished rats. There were no significant differences between groups in terms of trials to extinction.

The same general procedure was used in the second experiment but with the following exceptions: the blinking light was replaced by an intermittent buzzer, the number of escape trials was decreased from 40 to 20, lower shock intensities (50 v) were used during acquisition and punished extinction, and one "booster" escape trial was administered on the first day of regular or punished extinction. In addition, extinction conditions were approached gradually for all subjects. For the regular extinction group shock intensities in the startbox and alleyway following the booster trial were 50 v on the first extinction trial, and 45, 40, 30, and 20 volts respectively, for the second through the fifth extinction trials. Thereafter no shock was applied to any part of the alleyway or startbox. An identical procedure was followed for shock intensity in the startbox for the group punished in the entire alley, and first 4 ft of alley for the group punished in the last 2 ft of the alley. Rats punished in the entire alley were most resistant to extinction, followed by those shocked in the last 2 ft, and then by the regular extinction rats. In addition, rats punished in the entire alley ran faster than the regular extinction rats, in each of the three 2-ft segments, and the group punished in the last 2-ft segment ran faster than the regular extinction rats in the last 2-ft segment. Although this result could be due to the putatively dynamogenic effects of shock, the authors reported that rats punished in the last 2 ft ran faster in the middle segment than in the first segment, a result which is not consistent with the dynamogenic-effect interpretation. The authors interpreted their results as demonstrating "masochistic-like" behavior in their rats and as being in agreement with Mowrer's fear interpretation of vicious-circle behavior. They suggested, following Mowrer, that punished rats run during extinction because they are afraid, are shocked because they run, experience fear reduction in the goalbox which reinforces running, and continue to be afraid because they are shocked. In addition, the theory was expanded to include the notion that shock offset occurring as the animals ran off of the electrified section of grid provided potent primary reinforcement for running in the presence of the alley cues. They also noted that their results were in agreement with both a Guthrian notion of negative adaptation, wherein aversive stimuli lose their negative properties to the degree that they become cues for incompatible responses, and with a stimulus-similarity discrimination hypothesis (Church, 1963), wherein the more similar the extinction conditions are to those of acquisition, the more persistent the extinction behavior. The authors suggested, as had Seward and Raskin, that the stronger the to-be-punished response the less likely would punishment be to elicit a competing response, and that greater facilitative effects might occur with milder punishment. They also proposed that the increased speed between the first and second segments of the alley for rats punished in the last segment might be attributed to a fractional anticipatory shock-approach or escape reaction comparable to Hull's rg-sg mechanism.

Melvin (1964) investigated the effects of differing percentages of punishment during the extinction of a partially or continuously reinforced escape response. He gave his rats 12 trials per day in the same apparatus as used by Brown et al. (1964) in their second experiment. On the first day they received 9 shaping trials followed by 3 full-alley acquisition trials. On these last three trials 60 v shock was present on every trial for the 100% reinforcement group, on only two of these trials for the 67% reinforcement group, and on only one trial for the

33% reinforcement group. On Day 2 the same ratio of shock-escape to no-shock trials was administered. On the third day the first 3 trials were training trials with the appropriate percentage shock for each group, while the last 9, and all additional trials, were extinction trials. Each of the three groups was divided into two or more subgroups, one which received no-shock regular extinction, and one which received punished extinction with shock given on every trial in the last 4 ft of the alley. Finally, two additional subgroups were formed; one of rats trained with 33% shock-escape-trials and extinguished with 33% punishment, and another of rats trained with 67% shock-escape-trials and extinguished with 67% punishment. There were eight rats in each of the eight subgroups. The ITI on all trials was 9-11 min and the extinction criterion was failure to enter the goalbox within 60 sec. Melvin reported that the punished subjects completed more trials before extinguishing than did the nonpunished rats, and that rats given partial-reinforcement during acquisition and 100% punishment during extinction completed more trials than their partially-punished counterparts. Running speeds in the prepunishment and shock segments of the alleyway also reflected these relationships, although the prepunishment differences were not statistically reliable. Melvin interpreted these results as supporting the notion that punishment may facilitate the performance of a punished act, and as generally supporting Mowrer's fear interpretation of vicious-circle behavior. He also pointed out that his results were in contradiction to the stimulus-similarity discrimination hypothesis because the punished subjects that received the same percent punishment during extinction as they had during acquisition didnot perform as well as comparable groups with 100% punishment during extinction.

Martin and Melvin (1964) published an investigation of the effects on self-punitive behavior of shock-zone location. The apparatus was a 6-ft alley separated by guillotine doors into 1-ft startbox, 4-ft runway, and 1-ft goalbox sections. The startbox and runway had grid floors while the goal area had a wooden floor. Three groups of 23-hr food-deprived rats were given 16 massed shaping and escape acquisition trials at an ITI of 1 min; all rats remained in the goalbox for 30 sec following each trial. Immediately after acquisition the rats were given either regular no-shock extinction trials, or trials on which shock was present only in the first 8 in. of the runway for one group, and only in the last 8 in. of the runway for a second group. Shock intensity on the last 12 acquisition trials and all punished trials was 65 v (through 10 K ohms). Startbox time, the time the subject spent in the startbox before the guillotine door was raised and the trial began, was 3 sec on all trials. Subjects were run until they reached an extinction criterion of one failure to enter the goalbox within 60 sec or had completed 60 extinction trials. The group that was shocked in the first 8 in. was more resistant to extinction than that shocked in the last 8 in., and both were more resistant to extinction than the regular extinction group. Although there was little difference in full-alley running speeds between the group punished in the last 8 in. and the unpunished group, the group punished in the first 8 in. ran much faster than either of these groups. The authors interpreted their results as supporting Mowrer's fear notion of self-punitive behavior. They suggested that perhaps the near-punished group's performance was better than the far-punished group's because shock terminated sooner for rats in the former group. Thus, near-shocked subjects received more immediate reinforcement for forward locomotor responses. In addition, shock close to the goal area should have been less likely to generalize to the starting area than would shock near the startbox. Thus, far-shocked rats might have been less fearful in initial sections of alleyway and less likely than near-shocked rats to traverse the preshock sections, experience shock, and recondition their fear of alleyway cues.

Brown, Anderson, and Weiss (1965) performed a study designed to determine whether the facilitative effects of punishment observed with relatively spaced trials, as had been the case in Brown et al. (1964), would also be obtained with massed-trial training and extinction. In their experiment, 23-hr food-deprived rats, 14 to a group, were given 12 shaping and shock-escape training trials (45-50 v through 10 K ohms) in the same 6-ft alleyway with bi-level starting segment and dissimilar goalbox as used in the 1964 Brown et al. study. Twenty sec after the last escape trial, punished or regular extinction conditions were instituted with trials occurring at the rate of one every 20 sec. For punished rats the shock intensity in the startbox and alleyway on the 13th trial was reduced to 40 v, on the 14th trial to 30 v, and to 20 v on the 15th trial. No shock was presented on any future trials for regular extinction rats. One punished group was given this sequence of progressively decreasing shocks in the startbox only, but continued to be shocked in the entire alleyway, while a second was given the sequence in the startbox and first 4 ft of the alleyway, and was punished during extinction only in the last 2 ft of the alley. The rats were run until they reached a criterion of failure to enter the goalbox within 60 sec or until they had completed 60 trials. The long-shock rats had only slightly faster full-alley running speeds than far-shock rats. Both ran substantially faster than unpunished rats. In terms of trials to extinction similar outcomes were reported. Only 3 of the long-shock rats extinguished, whereas 6 of the far-shock rats, and 12 of the unpunished rats met the extinction criterion. The authors interpreted these results as confirming and extending the earlier findings of Brown et al.

In a subsequent study, Melvin, Athey, and Heasley (1965) studied the effects of shock location and duration on self-punitive running using the same 4-ft runway used by Melvin and Martin (1964). Their only apparatus modification was the addition of a CS, a buzzer, which was turned on 0.5-1.0 sec prior to the beginning of each trial when the startbox guillotine door was raised. When each rat entered the goalbox the second guillotine door was lowered and the CS was terminated. On every trial the rat remained in the goalbox for 30 sec. All rats received 16 acquisition trials, the last 12 of which were full-alley shock-escape (up to 70 v) trials. Immediately following the 45-sec ITI, extinction conditions were instituted for the 9 rats in each of the 3 punished and 1 regular-extinction groups. Rats in one punished group were shocked in the first 8 in. of the alleyway, those in a second in the last 8 in. of the alley, and those in a third in the entire alley but, as with the others, not in the startbox or goalbox.

All rats were run until they completed 100 extinction trials or until they reached the criterion of one failure to enter the goalbox within 60 sec. The authors reported that the punished rats had higher full-alley speeds and completed more trials prior to extinguishing than did the unpunished rats. The near-shock group was fastest, followed by the far-shock, the full-alley-shock and finally the unshocked rats. Median trials to extinction, given in the same order, were 100+, 52, 29, and 27. The near-shock animals were significantly more resistant to extinction than were either the far- or full-alley shock rats. The authors suggested that their results were inconsistent with a stimulus-similarity discrimination hypothesis. The group that was most facilitated by shock was not the full-alley shock group, the group for which conditions of punished extinction were most like those of acquisition, but instead the near-shock group. They noted that an unelaborated version of Mowrer's theory would also not account for this difference because more fear should be conditioned for the full-alley shock rats than the near-shock rats. Instead, they suggested that a Mowrer-Brown interpretation would be more appropriate; Mowrer's fear interpretation in conjunction with the notion offered by Brown et al. (1964), that shock-offset provides primary reinforcement for forward locomotion. While the close proximity of the shock to the starting area may yield maximum fear of the starting area cues and a relatively optimal CS-US interval for fear conditioning for rats in both groups, the near-shock rats alone would experience prompt primary reinforcement for the forward locomotor response. In addition, since the shock zone extended to the goal for rats shocked in the entire alley, there might have been substantial generalization of fear to the goalbox for those rats.

Seward, King, Chow, and Shiflett (1965) reported a study designed to discover if the important factor that determines whether punishment facilitates or suppresses ongoing behavior is the intensity of the punishment. One hundred and twenty rats were given shock-escape training in an unpainted 53-in. long alleyway with a similar grid-floored 13-in. starting section and black-painted 12-in. goal section with wooden floor. The goal section was separated from the alley by a translucent guillotine door. Forty rats were given escape training with a 95-v shock (through 150 K ohms), 40 with a 155-v shock, and 40 with a 215-v shock. Each rat was dropped by hand into the alley at the beginning of each trial. Twenty massed acquisition trials were given with an ITI of 30 sec during which time the rat remained in the goal area. Immediately after training, each group was divided into 4 subgroups of 10 rats each, 1 regular extinction subgroup and 3 punished subgroups. Rats in one punished subgroup were punished with 95-v shock, those in the second with 155 volts, and those in the third with 215 volts. Shock in the entire alley was turned on if a rat broke a photobeam at the center of the alley. Extinction trials continued until each rat had completed 60 trials or until it had reached a criterion of failing to reach the center of the alley within 60 sec on two successive trials. Shock intensity during acquisition proved to be a significant source of variance among acquisition running speeds; the more intense the shock the faster the speeds. In addition, the higher the training-shock intensity, the more trials the rats completed during extinction. Although rats punished during extinction required <u>fewer</u> trials to reach the extinction criterion than nonpunished rats, the intensity of the punishing shock was not an important determinant of the number of trials completed during extinction. Full-alley running speeds were reported for <u>only</u> those rats that did not meet the extinction criterion. In terms of these speeds, the groups punished with the strongest shocks ran fastest. The authors also noted that the stronger the intensity of punishment, the more suddenly the rats seemed to extinguish. They interpreted their results as suggesting two opposed functions of punishment, facilitative and inhibitory. Of rats which did not meet the extinction criterion, punished rats ran faster than nonpunished rats. More punished rats extinguished, however, than nonpunished rats.

A study involving the effects of intensity and duration of punishment during the extinction of an avoidance response was reported by Seligman and Campbell (1965). These authors suggested that variations in those parameters might be responsible for some of the reported differences in the effects of punishment. Their apparatus was a 30 in. runway with two similar 9-in. interchangeable start-goal boxes separated from the runway by guillotine doors. A 10/sec 76.5-79.5 dB clicker was used as an avoidance CS on each trial. All rats received avoidance training (at an ITI of 45 sec) until they reached the acquisition criterion of 9 successive responses with latencies less than the CS-US interval of 5 sec. Shock intensity during acquisition was 300 v (through 150 K ohms). During extinction, punished groups received goalbox punishments of either 0.15 sec, 0.50 sec, or 2.00 sec duration, factorially combined with punishment intensities of 45, 72, 115, 185, or 300 v. An unpunished group was also included. All rats were run until they reached an extinction criterion of failing to break a photobeam at the entrance to the goalbox within 45 sec after the onset of the CS, or until they had completed 150 extinction trials. The authors reported that the median number of extinction trials was inversely related to both shock duration and intensity. They suggested that the conditions of the experiment met two of the criteria suggested by Brown, et al. (1964) for producing facilitative effects of punishment, namely, the punishment was relatively mild and the response was well established. They commented that these two factors were, however, insufficient by themselves to produce facilitation, and that more research was needed to delineate the conditions under which suppression and/or facilitation would be observed.

Smith, Misanin, and Campbell (1966) published a study of the effects of intensity and duration of punishment upon the extinction of avoidance responding learned to three different acquisition criteria. Rats were trained to avoid shock in an automatic shuttlebox composed of two identical grid-floored compartments separated by a partition. A top-hinged door in the partition allowed the rats free access to both compartments. The US intensity during acquisition for all rats was 185 v. Rats were given massed training with ITIs of 30 sec until they reached a criterion of 2, 4, or 8 successive responses (depending upon their group assignment) with latencies shorter than the 5 sec CS-US interval. Following acquisition the three groups were each divided into two subgroups in which the rats were given short (.15 sec) or long (2.00 sec) duration punishment as they pushed open the door between the compartments. Factorially combined with the three avoidance acquisition criteria and two shock durations were five shock intensities, 45, 72, 115, 185, or 300 v. There were eight rats in each of these 30 experimental groups and in three regular extinction groups, one trained to each of the three acquisition criteria. The results provided no evidence of facilitation by punishment. Instead, the shock intensity and duration were inversely related to the level of extinction performance, both in terms of response latencies and the proportion of responses occurring during the 5 sec following CS onset. The authors suggested that the suppression might have been due to their procedure of shocking the rats as they pushed open the door. This could condition fear to the door, tending to interfere with the shuttle response. Although they did not deny the possibility of punishment-produced facilitation of responding under other circumstances, they suggested that such facilitation is probably the exception rather than the rule, and that the conditions determining whether facilitation or suppression will occur are not well known.

In commenting on the Smith, et al. study, Martin and Melvin (1966) noted that the experimental conditions were not designed to maximize the possibility of obtaining facilitation by punishment and presented several possible arguments to support their suggestions. First, punishment was delivered at the end of the response sequence, in the goal-box. Such a procedure might be expected to suppress, rather than facilitate, responding because the starting and goal cues were identical. The rats would have left a place where they had been shocked only to enter a place where they had been shocked. A crucial factor then, according to Martin and Melvin, was the location of shock in the response sequence. In addition, they noted that the swinging door would have provided very salient cues to which fear could have become conditioned, and which would have clearly marked the location of punishment. One might wonder, however, if such distinctiveness necessarily works against punishment-produced response facilitation since Gwinn (1949) used a visibly distinct shock zone but reported clearly facilitative effects of shock. Finally, they pointed out that Smith et al.'s conclusion, that suppression is the general outcome of punishment, is too general, and should be qualified to include avoidance paradigms only. They also suggested, in contradiction to Smith, et al., that some of the conditions under which punishment would be expected to facilitate behavior have been delineated, by Mowrer (1947), Brown et al. (1964), and Brown et al. (1965).

In reply, Smith, Misanin, and Campbell (1966a) suggested that Martin and Melvin's view of vicious-circle behavior was too narrow. It was not originally intended by either Mowrer or Brown, to include only situations in which punishment was presented in the middle of a response sequence. Instead, it should apply whenever fear could generalize to cues present at the beginning of a trial. In addition, they countered Martin and Melvin's comment that in the Smith et al. study shock necessarily came at the end of a response sequence. They reported that many of their rats would run through the swinging door, were shocked, and then rushed back into the starting area. Thus shock, which occurred as the rats entered the "goal area" occurred in the middle of the response sequence. They also noted that even when many of the conditions suggested by Mowrer-Brown theory were met, as in Brown et al. (1964), Experiment 1; Seward and Raskin (1960); and

Seward et al. (1965), punishment-produced facilitation did not occur. In closing, they reaffirmed their statement that punishment-produced facilitation is the exception rather than the rule.

Melvin and Martin (1966) reported an experiment in which two qualitatively different aversive stimuli were used with two groups of rats during acquisition, and either the same aversive stimulus, the alternative stimulus, or no aversive stimulus, was presented during extinction. One stimulus was conventional shock (50 v through 10 K) while the other was a noxious buzzer (101 dB, 60 dB above background) mounted on the rear of the startbox wall. The apparatus was a 4-ft alleyway with 1-ft starting area and 1-ft goal area. This was the same apparatus used by Martin and Melvin (1964) except that the guillotine door separating the starting area and alley was removed and a bi-level, trapdoor-floored startbox similar to that used in the Brown, et al. studies was added. Sixteen massed shock- or buzzer-escape trials were administered, separated by a 30-sec ITI, which the rat spent in the goalbox. Immediately following acquisition either punished or regular extinction conditions were instituted; punished rats were presented with a fixed-duration (0.3 sec) shock or buzzer if they entered the alley. All rats were run until they completed 100 extinction trials or until they failed to enter the goalbox within 60 sec. Melvin and Martin reported that the shock-punished rats trained with either shock or buzzer, and the buzzer-punished rats trained with shock, completed more trials during extinction, and had both faster starting and running speeds, than did the unpunished rats. The buzzer-trained buzzer-punished rats, however, did not differ on these dependent measures from the unpunished rats. Melvin and Martin noted that their results extended the boundary conditions under which self-punitive behavior had been observed. Their punishing stimuli were qualitatively different from their training stimuli for some groups, and the punishment was temporally rather than spatially controlled. They also indicated that although their results were in general agreement with the Mowrer-Brown hypothesis, they were in part contradictory to the stimulus-similarity discrimination hypothesis. The buzzer-trained shock-punished group performed better than the buzzer-trained buzzer-punished group. This would not have been expected from a theory demanding that the most facilitation occur where the extinction conditions are most nearly identical to acquisition conditions. They also pointed out that the extinction criterion which they used, failure to enter the goal area within a certain time (similar to that used by Melvin, Martin, Brown, Gwinn, and others) would be more likely to yield results favoring the facilitative effects of punishment than would criteria such as used by Seward, et al. (1965), viz, failure to reach the center of the alley. This was because regular extinction rats are commonly observed to cease running near the middle of the alleyway after numerous extinction trials, whereas punished rats tend to freeze in or near the startbox. As Church (1963) has noted, the extinction criterion is a salient factor in studies of self-punitive behavior.

Campbell, Smith, and Misanin (1966) reported a study in which they investigated the effects of shock during the extinction of an avoidance response, using the massed-trials procedure. Rats were first given avoidance acquisition with an ITI of 40 sec and a CS-US interval of

5 sec. The CS was a 75 dB clicking noise while the US was a 185 v shock (through 150 K ohms). They used a 7-ft alleyway with interchangeable 1-ft start-goal boxes. Acquisition was continued until the rats completed 4 successive avoidances. Rats which did not reach this criterion before the 40th acquisition trial were discarded. Those in one group were given 0.15 sec duration shock when they passed a photobeam 4 in. outside the startbox, those in a second group the same duration shock when they passed a photobeam 8 in. in front of the goalbox, while those in a third group were not punished. Extinction continued until the rats failed to enter the goal area within 60 sec or completed 150 trials. During extinction, goal-punished rats made significantly fewer short latency responses (less than 5-sec latency), and required significantly fewer trials to reach the extinction criterion, than those in either the start-punished or regular extinction groups (which did not differ on this measure). Start-punished rats, however, ran significantly faster on their last extinction trial than either the goal-punished or unpunished rats. Campbell et al. noted that start-punished rats showed decreased latencies in leaving the starting area over trials, while the regular extinction and goal-shocked rats showed increased latencies. Unpunished rats displayed a tendency to spend increased time in the center portions of the runway during extinction while the start- and goal-punished rats did not. The authors interpreted these results as supporting the notion that the application of punishment during extinction can have either inhibitory or facilitative effects, depending on its location in the response sequence. In addition,

they suggested that the results, in general, support the conditioned-fear interpretation of vicious circle behavior. They added that, in their opinion, either increased resistance to extinction or increased vigor of responding, would be a sufficient defining characteristic of self-punitive or vicious-circle behavior.

In 1967 Beecroft and his associates reported a series of experimental studies of self-punitive behavior, the first of which dealt with the location of the shock zone during punished extinction. Beecroft (1967) suggested that the suppression of running demonstrated for the rats shocked near the goal in the Campbell et al. experiment might have been due to any of numerous possible factors: the temporal rather than spatial control of the shock, the nature of the apparatus, or possibly the type of aversive training procedure used during acquisition. He performed an experiment in which rats were trained and tested in the same 6-ft alleyway, with bi-level startbox, and dissimilar goalbox, as used in the studies by Brown and his colleagues (Brown, Martin, & Morrow, 1964; Brown, Anderson, & Weiss, 1965; etc.). Massed shaping and avoidance acquisition trials (ITI of 70-80 sec) were given until the rats reached a criterion of three successive avoidances. The avoidance interval was 3 sec and the US was 55 v (through 10 K ohms). Massed regular extinction trials were then implemented for half the rats while the other half were given punished extinction with 55 v shock in the last 1 ft of the alleyway. All rats were run until they completed 100 trials or until they failed to enter the goalbox within 60 sec. The rats in the punished extinction group completed four times as many trials during extinction as did the unpunished rats, and ran substantially faster than the latter in a prepunishment (the first 4 ft) section of the alleyway. Beecroft suggested that since near-goal punishment led to facilitation during extinction under these conditions, some other factor, such as the particular apparatus or procedure, would have been necessary to account for Campbell et al.'s results.

In a second experiment (Beecroft & Bouska, 1967) punished rats actually demonstrated better performance during extinction than they had at the end of acquisition. They were first given 8 shaping and 2 full-alley escape trials on one day. On the next day the rats were matched for running speeds and given 10 trials of either regular (no-shock) extinction or punished extinction with shock present in the last 2 ft of the alleyway. All trials were spaced with an ITI of at least 5 min. Running speeds during the 10 extinction trials were significantly faster for the punished than for the nonpunished rats in the 4-ft <u>preshock</u> alley segment. In addition, the punished rats' speeds <u>increased</u> during extinction while those of the unpunished rats <u>decreased</u>. Three of the unpunished rats met the extinction criterion of failing to enter the goalbox within 60 sec while none of the punished rats did so. Beecroft and Bouska proposed that punished rats might have been speeding up to traverse the shock zone with a minimum of delay and/or could have become increasingly motivated as they became more and more fearful of starting area and preshock segment cues. In addition, Beecroft and Bouska speculated that their rats might possibly be learning to be self-punitive during the extinction phase of their experiment.

In a third experiment (Beecroft & Brown, 1967) punished extinction performance was compared for rats given escape, avoidance, or partial-avoidance training. Following escape (45-50 v through 10 K) shaping trials for all rats, four groups were randomly selected. One group received escape training (0-sec shock delay), two were given avoidance training (2- and 4-sec shock delays) and one partial-avoidance (1-sec shock delay). The 1-sec delay was long enough so that rats could avoid some but not all of the shock in the alleyway. Following 50 acquisition trials (10 per day) punished extinction conditions were initiated for rats in all groups; shock (55 v) was present in the last 2 ft of the alleyway. During the acquisition phase the 1-sec rats ran fastest and the 4-sec rats slowest in each of the three 2-ft segments of the alleyway. The 2-sec rats were faster than the 0-sec rats in the first and second 2-ft segments while their order was reversed in the third. The 0-sec rats showed less resistance to punished extinction than either partial-avoidance or avoidance-trained rats. The extinction speed data are uninterpretable. Only the rats which did not meet the extinction criterion (failure to enter the goal-box within 60 sec) were included, and the number of rats meeting this criterion in each group was not provided.

The intensity of punishment during extinction was manipulated in a fourth experiment (Beecroft, Bouska, & Fisher, 1967) in which the same 6-ft alley was used. Rats were given massed avoidance training (with an ITI of 60 sec) until they completed one successful avoidance. During acquisition the US was 55 v (through 10 K ohm). The rats were then administered either regular or punished extinction trials. One group of punished rats encountered 40 v shock in the last 1 ft of alleyway, one group 55 v shock, and a third group 70 v shock. The results indicated that all punished groups had faster alley speeds, and required more trials to reach the extinction criterion of failure to enter the goalbox within 60 sec, than did unpunished rats. The 55-v-punished rats required more trials to extinguish than either the 40-v- or 70-v-punished rats. These results supported a discrimination hypothesis stressing the similarity of acquisition conditions to extinction conditions. Further support was provided by the results from two additional groups of rats which were run later. They were trained with 70-v shock and given punished extinction with either 55-v or 70-v shock. Those punished with 70-v shock completed arithmetically (but not significantly) more extinction trials than those punished with 55-v shock.

The first experiment demonstrating self-punitive locomotor behavior using rats and a within-subjects design was reported by Melvin and Smith (1967). Their rats were first given massed avoidance training (ITI of about 1 min) in a 4-ft alleyway having a bi-level startbox and dissimilar goalbox. The CS was a buzzer which was turned on as the rat dropped into the lower level of the startbox and preceded the 50-v shock by 5 sec. Acquisition continued until the rats reached a criterion of five successive avoidances. Following acquisition, one group received 30 regular extinction trials followed by 20 punished extinction trials with shock present in the second foot of the 4-ft alley. The second group was first given 30 punished extinction trials followed by 20 regular extinction trials. During the first 30 extinction trials the speeds of the punished rats increased and were significantly faster than those of the unpunished rats. The speeds of rats punished on the first 30 trials decreased on the last 20 trials, however, while those of the rats given regular extinction on the first 30 trials and punished extinction on the last 20 trials increased on those last 20 trials. Running speeds, over the last 20 trials, were significantly greater for rats punished on those trials than for the rats punished on the first 30 trials.

Melvin and Smith proposed that the running speed increases shown by rats in both groups during the trials on which they were punished had the appearance of learning curves. Perhaps, they speculated, the rats were learning to run faster during punished extinction, because faster running might be reinforced by shorter shock durations when the rats crossed the electrified segments of the alley. In addition, they suggested that their results had methodological significance since they demonstrated that the self-punitive phenomenon can be studied using a within-subjects design.

Williams, in 1967, reported a series of three studies dealing with self-punitive behavior. The first study was designed to address the hypothesis that varying the shock zone location would lead to facilitated self-punitive running because no alley cues would reliably precede the shock zone location. In this experiment rats were given acquisition and extinction trials in a 6-ft straight runway with a trapdoor-floored bi-level startbox and dissimilar goalbox. Following the first day of acquisition, on which each rat received 5 massed trials, each rat was given 2 spaced trials per day, at an ITI of 30 min, until a total of 40 was reached. A buzzer came on 5 sec prior to the beginning of each trial and continued until the rat entered the goalbox. All rats were maintained at 80% of their _ad lib_ weight throughout the experiment.

Half were extinguished without shock and half with shock. For punished rats the location of the 1-ft shock zone was varied randomly from trial to trial. The extinction criterion was failure to enter the goalbox within 60 sec. The results indicated that rats in the varied shock location group ran significantly faster than those in the regular extinction group but were only slightly more resistant to extinction ($p = .08$). Williams concluded that the resistance to extinction of the punished rats was not exaggerated as his hypothesis had predicted. Unfortunately, he provided no fixed shock-zone location group to which he could compare his varied-shock-location group.

His second experiment was similar to the first but did include a "fixed location" group. Rats were given escape shaping and acquisition in the same apparatus that had been used in the first experiment. The procedure was also similar, with only one major difference. The 12 daily trials were spaced at 1-hr intervals. Following one day of shaping and one day of escape acquisition three groups were selected. They were matched in terms of their full-alley speed scores. The first group then received regular extinction trials, a second group punished extinction trials using the varied-shock-zone procedure of the first experiment, and a third group was extinguished with "fixed" location shock. Of the 12 rats in the latter group, 2 always encountered shock in the first 1 ft of the 6-ft alley, 2 encountered shock in the second 1 ft.,etc. Each rat was given 96 extinction trials. On those trials on which the rat did not reach the goalbox within 60 sec it was removed and placed in the holding cage to await its next trial; no rat was discarded for failure to run. According to Williams the unpunished rats frequently ran on trials after the one on which they had met the typical extinction criterion of failure to enter the goalbox within 60 sec. Punished rats, on the other hand, seldom ran again after the trial on which they reached the extinction criterion. Overall, punished rats ran slightly faster than did the unpunished rats ($p = .10$). The unpunished rats, however, tended to be slightly more resistant to extinction. In addition, there was a significant trials x punishment group interaction; the fixed location group ran faster on initial trials, but slower on later trials, than the varied location group. From these results Williams concluded that there is little difference between the extinction performance of rats punished with fixed or varied location shock. He criticized the usual procedure of counting as extinguished any rat which failed once to enter the goalbox within some time period during extinction. He suggested that such procedures, and the customary assignment of identical low speed scores to such rats on all "post-extinction" trials, tends to reduce group variance and to inflate between groups F-ratios. It seems, however, that this would not be true in many cases. Suppose only a few rats in a group met some extinction criterion and were assigned arbitrary low extinction scores for all additional trials instead of the higher scores they might have received. Variance then, calculated by summing the squared-differences between each speed score and the mean speed, could be inflated more by assigning a large number of low scores than it would had the animal been run additional trials and its higher speeds been analyzed. Williams also suggested that mean speed data may be misleading since his punished rats either ran fast or did not run while the regular extinction rats tended to run more slowly but more consistently. The higher mean speeds frequently reported for punished groups could, therefore, be the result of observing and averaging the scores of some fast-running and some non-running rats while the lower mean speeds of the unpunished rats might be based on speed averages from many slow-running rats. It would seem, however, that the analysis of variance procedure usually used to detect group differences takes such disparities in variance into account.

In Williams' third experiment intertrial-interval was manipulated. He used a 4-ft alleyway in which a similar starting area and dissimilar goal area were separated from the alley by guillotine doors. All rats received 12 trials per day. The ITI was 1 min for rats in the first group, 6 min for those in the second, 20 min for those in the third, and 60 min for those in the fourth. After 30 escape trials half the rats in each group were extinguished without shock whereas the other half always encountered punishment in the last 39 in. of the alley. Each rat was detained for 10 sec in the goalbox after each trial and then returned to the home cage for the remainder of the ITI. Punished rats from the 1-, 6-, and 20-min groups completed more trials during extinction than did their nonpunished counterparts, whereas the punished and nonpunished rats in the 60-min groups did not differ. Williams interpreted these results as being consistent with an hypothesis stressing the importance of the internal after-effects of shock which might dissipate over time. Although he suggested that the results might also help to explain why the punished groups in his second experiment might not have shown greater shock-produced facilitation, this is somewhat questionable since the procedures used in the two experiments differed markedly.

Delprato and Denny (1968) reported two experiments, based on the concepts of relaxation and relief, in which time in the goalbox was manipulated. In both of these studies the rats were trained and extinguished in an apparatus consisting of an 11-in. white (or black) startbox, a 14-in. gray alley, and an 11-in. black (or white) goalbox. Guillotine doors separated the starting and goal areas from the alley. In the first experiment, acquisition consisted of placing the rats into the starting area, turning on the 68-dB buzzer (CS) and raising the starting and goalbox doors after a delay of 75 sec and 5 sec later turning on the 1.0 ma shock US if the rat had not yet entered the goalbox. The CS and US terminated when the rat entered the goalbox and the door was lowered. Each rat remained in the goalbox for 75 sec after which it was placed back into the startbox to begin the next trial. After each rat had completed two successive avoidances, extinction conditions were imposed. During extinction a third of the rats were confined in the goalbox for 2 sec on each extinction trial, a third for 15 sec, and a third for 30 sec. Their pre-CS startbox times were 148, 130, and 120 sec, respectively. Half of the rats having each goalbox confinement time were punished in the alleyway while the other half were not. All rats were run until they completed 80 trials or failed to enter the goalbox within 60 sec on two consecutive trials. The punished rats had higher alleyway speeds over the first 30 trials than the unpunished rats. In addition, alley speed (averaged for both punished and unpunished rats) was an increasing function of goalbox confinement duration. The confinement by punishment interaction, however, was not significant.

In the second experiment the same apparatus was used and the acquisition procedure was similar to that in the first experiment although startbox and goalbox times were reduced to 16 sec each. During extinction, startbox time was extended to 30 sec and two goalbox confinement durations were used, 2 or 30 sec. Rats given 2-sec goalbox confinements were held in a distinctive holding chamber for 30 sec after removal from the goalbox. They were then placed into the starting area to begin their next trial. Half of the rats within each goalbox confinement group were punished in the alleyway during extinction while the other half were given regular extinction trials. The punished 30-sec group required significantly more trials to extinguish than did the 30-sec nonpunished rats, but punished and nonpunished rats with only 2-sec goalbox confinement did not differ. Alley running speeds mirrored these results.

Delprato and Denny interpreted their results as supporting their view that punishment only prolongs running during extinction when goalbox confinement time is sufficient for unconditioned and conditioned relief to occur. Conditioned relief was said to be the learned component of unconditioned relief which accompanies shock offset. Since there is little time for relief to be elicited for rats given only 2-sec goalbox confinement, and relief serves as a powerful reinforcement for running, little shock-produced facilitation would be expected. Longer goalbox confinements, however, would be expected to lead to improved extinction performance for both punished and nonpunished subjects. Relaxation, a long latency (25-40 sec) response, follows the offset of either conditioned or unconditioned aversive stimuli. Because relaxation would occur in the goalbox for rats in the long confinement groups, and cues contiguous with the onset of relaxation are said to acquire reinforcing properties, rats in long confinement groups should complete more extinction trials than those in short confinement groups where relaxation does not occur in the goalbox. Alternatively, we may interpret this experiment as one in which the duration of fear reduction in the goalbox was manipulated. The results of these experiments, then, would be in agreement with predictions based on a conditioned fear interpretation of self-punitive behavior if it were modified to stress the importance of fear reduction in the goalbox following a response.

An experiment investigating the effects of partial-punishment during extinction of a 100%-reinforced escape response was reported by Martin and Moon in 1968. They noted that Melvin (1964) had demonstrated, in a study of partial-punishment of a partially-reinforced escape response, that extinction performance was an increasing function of percent punishment. Beecroft, Fisher, and Bouska (1967) however, had reported that during extinction of a continuously-reinforced avoidance response self-punitive locomotor behavior was independent of percent punishment from 20% to 100%.

Martin and Moon's apparatus consisted of a white 1-ft startbox, a white 4-ft alley, and black 1-ft goalbox. Guillotine doors separated the startbox and goalbox from the alley. After massed (30 sec ITI) escape acquisition trials regular extinction conditions were instituted for rats in one group and punished extinction conditions for rats in two additional groups. Rats in one of the punished groups encountered shock in the first 18 in. of the alley on every trial while those in the other encountered shock there on only a third of the trials. The punished rats ran more extinction trials than the nonpunished rats, but the partially-punished rats did not differ from the continuously-punished rats. Alley speeds, however, were faster for punished rats than nonpunished rats, and for continuously-punished than for partially-punished rats. These results, then, were consistent with those of Beecroft et al. (1967) and suggest that Melvin's (1964) earlier findings may have been dependent on his use of partial-reinforcement during acquisition.

Melvin and Bender (1968) investigated the effects of manipulating shock intensity during punished extinction. Female rats were trained and extinguished in a 4-ft alleyway with a bi-level startbox and a dissimilar goalbox. During massed-trial avoidance acquisition (ITI = 30 sec) the buzzer CS was energized as the rats were dropped into the alleyway. If they failed to enter the goalbox during the 5-sec CS-US interval the 55 v US was presented. After reaching the criterion of 5 successive avoidances (within the first 25 trials) each rat was given regular extinction trials. Following the 15th trial one group of rats was punished during extinction with a constant 70 v in the first 2 ft of the alleyway, a second group was punished with a shock of increasing intensity over trials (from 40-70 v), and a third group was punished with shock of decreasing intensity over trials (70-40 v).

No rat in any group met the extinction criterion of failure to enter the goalbox within 60 sec, and all of the rats ran faster during the punished extinction than during the first 15 regular extinction trials. Running speed was an increasing function of shock intensity for each group, but was greater at every intensity for rats in the decreasing intensity group than for rats in the increasing intensity group.

In a second experiment, similar to the first, the sex of the rats was included as a factor in a 2 x 2 factorial design. The acquisition procedures were identical to those in the first experiment. During extinction half the rats were given regular extinction trials. The other half were given punished extinction trials with shocks of increasing intensity similar to those given rats in the increasing intensity group in Experiment 1 except that shock was located in only the first 12 in. of the alley. The female rats ran faster than the male rats, overall , and had higher running speeds during regular extinction. Again, the punished rats completed more trials than the nonpunished rats, and had faster alley speeds.

A study by Melvin and Stenmark (1968) was based on one of the major premises of the Mowrer-Brown theory of self-punitive behavior, i.e., that during punished extinction rats are motivated by fear to leave the prepunishment sections of the alleyway. If this were so, one might expect that rats trained to traverse the alley with fear reduction alone as the reinforcement might also be caught up in the vicious circle if shock were introduced into the alley during extinction.

Melvin and Stenmark gave their rats 18 pairings of a buzzer CS and 65 v US in the lower level of a bi-level startbox. Following these massed (40-80 sec ITI) fear-conditioning trials the rats were all given three no-shock trials on which they could leave the starting area, traverse the 4-ft alleyway, and enter the dissimilar goalbox to "escape fear." Following the last no-shock trial they were randomly assigned to one of five groups. The first was a regular extinction control, and the remaining four were punished groups which together comprised a 2 x 2 factorial design. One factor was shock intensity, 55 v vs. 75 v shock, while the second was shock location, the second 1-ft section of the alley or the last 1-ft section. Each rat was run until it failed to enter the goalbox within 60 sec or completed 40 trials.

The major finding was that fear-conditioning alone, without previous shock escape-training, was sufficient to serve as a basis for punishment-produced facilitation; all punished groups ran faster in the alley than the unpunished group. In addition, the 75 v-shocked rats ran faster than the 55 v rats, and those shocked in the second foot ran faster than those shocked in the last foot. Finally, running speeds of all punished groups sharply (and significantly) increased during the extinction phase. Melvin and Stenmark interpreted these results as supporting the conditioned-fear interpretation of self-punitive locomotor behavior and as extending the boundary conditions of the phenomenon to include behaviors motivated by fear but <u>not</u> acquired through primary reinforcement.

Galvani (1969) attempted to extend the interpretation of Melvin and Stenmark's experiment by manipulating the number of fear-conditioning trials administered prior to the extinction of a fear-escape response. If fear were a classically-conditioned response then it should follow the laws of classical conditioning and its magnitude or intensity should, within limits, be a function of the number of forward pairings of the CS complex and the US. Galvani gave rats in 4 groups 0, 1, 3, or 9 pairings of an 86 dB buzzer and a 55 v US in the lower section of the bi-level startbox (at a CS-US interval of 5 sec). Following four post-conditioning, fear-escape trials, half the animals in each group encountered shock in the second and third foot of the 4-ft alleyway while the other half received no shock. All subjects were run for 40 extinction trials or until they failed to reach the goalbox within 60 sec. Ninety percent of those that met the extinction criterion did so on the first extinction trial. All of the members of the regular extinction groups with 0, 1, and 3 pairings met the extinction criterion. Ninety percent of those given 9 pairings and then regular extinction, and 20% of the punished rats with 1 pairing, 40% of those with 3 pairings, and 100% with 9 pairings, however, did _not_ extinguish. Running speeds also reflected these relationships. Galvani suggested that these results supported a Mowrer-Brown conditioned-fear interpretation of self-punitive locomotor behavior since the greater the conditioned fear in the startbox the greater was the probability that the rats would run during extinction. Of the rats that did run, almost all that encountered shock became locked into the vicious circle for the remainder of their extinction trials.

A study by Bender (1969) was designed to investigate the effects of _secondary_ punishment on the extinction of an avoidance response. Secondary punishment was defined as the response-contingent presentation of a stimulus which had acquired aversive properties through previous forward pairings with a noxious US. In Bender's study four groups of 24-hr food-deprived rats were given 15 forward pairings of a buzzer CS and 80 v US at a CS-US interval of 30 sec and ITI of 150 sec. Rats in group 5 received random CS-US presentations while those in group 6 were given US-only presentations. All rats were then subjected to massed avoidance training in a 4-ft alley with a bi-level startbox and dissimilar goal-box. On these trials the CS-US interval was 3 sec and the US was 60 v. When rats from any of the first 4 groups reached the acquisition criterion of 5 successive avoidances (within 20 trials or the rat was discarded) they were given 1 of 4 extinction treatments. Those in group 1 were administered 100% secondary punishment (presentation of the fear-arousing CS if it entered the alley), those in group 2 received secondary punishment on one third of the extinction trials, those in group 3 both secondary punishment and 60 v primary punishment on all trials, and those in group 4 regular extinction. Rats in group 5 were presented with the (randomly-presented) CS on all trials if they entered the alleyway, whereas those in group 6 were presented the (novel) CS on all trials if they entered the alley. Alley running speeds were fastest for the rats (in group 3) that received both primary and secondary punishment, followed by those (in group 2) given 100% secondary punishment, then by those given 33% secondary punishment and those "punished" with the random CS (groups 2 and 5), and finally by those given regular extinction and those "punished" with the novel CS (groups 4 and 6). Resistance to extinction data mirrored these results. In addition, it was reported that the rats given partial secondary punishment (group 2) ran faster on CS trials than on no-CS trials. Bender interpreted these results as as demonstrating the facilitating properties of secondary punishment of an aversively motivated response and as thus extending the boundary conditions of self-punitive locomotor behavior. In addition, further support was provided for the conditioned-fear theory since putatively fear-motivated extinction responding was enhanced by presentation of fear-evoking stimuli.

Anson, Bender, and Melvin (1969) reported two studies in which punishment occurred for a fixed temporal duration rather than in a fixed location in the alley. In the first of these, rats given punished extinction with a fixed shock-zone length were compared to rats given punished extinction with a fixed-duration shock. The apparatus was a 4-ft alley with bi-level startbox and dissimilar goalbox. Following 12 massed escape acquisition trials, one group of rats was given regular extinction, a second was punished with shock confined to the second and third 1-ft sections of the alley, and a third group was punished with a fixed-duration shock of 0.4 sec that began as the rat entered the second 1-ft of the alleyway. This value was based on the average time that the first five rats in the fixed location group had been exposed to fixed-location shock. Six of the rats in the regular extinction group, 1 in the fixed-location group, and 3 in the fixed-duration group met the extinction criterion of failing to enter the goalbox within 60 sec during the 60 extinction trials. Full alley speeds reflected these differences; fixed location rats were fastest, followed by the fixed-duration rats which were only slightly slower, and then the unpunished rats which were much slower.

In the second experiment, rats were given massed avoidance training with an CS-US interval of 5 sec and a buzzer CS. When they had completed 5 successive avoidances, half were extinguished without shock and half were shocked on half the trials for 0.3 sec if they entered the second 1 ft of the alley. The punished rats ran faster on both shocked and non-shocked trials than did the unpunished rats, and completed significantly more extinction trials. The punished rats' speeds did not differ, however, between shock and no-shock trials. Over the 70 extinction trials the punished rats' speeds increased in the second 2-ft alley section on both punished and non-punished trials, but remained relatively constant in the first 2-ft section on both types of trial. To the authors these results indicated that the punishment-produced suppression reported by Campbell et al. (1966) was probably not a function of their use of a temporally controlled punishment, but rather of some other characteristic of their experiment, perhaps the interchangeable start-goal boxes. In addition, increasing running speeds (over trials) reported during punished extinction by many investigators (Melvin & Smith, 1967; Melvin & Stenmark, 1968; Galvani, 1969) were probably not a function of progressively increasing emotionality during massed-trial punished extinction because the effect seemed to be specific to a certain section of the alley. Instead, these increases were judged to be consistent with a modified conditioned-fear interpretation if an additional assumption were made that fear could be conditioned to certain spatial cues of the alleyway at or near the area where shock was presented during punished extinction. Another possibility was a conditioned-fear interpretation incorporating the idea that preshock cues acquired fear-arousing properties through their forward pairing with shock. Exposure to these cues could increase the rats' motivational levels, leading them to accelerate, and thus to display higher running speeds in following segments.

In 1969 Martin published the first of several studies designed to determine ways to stop self-punitive locomotor behavior. He argued that the large body of literature supports the Mowrer-Brown conditioned-fear interpretation, and proposed, therefore, that manipulations which reduced a rat's drive level should also serve to reduce its self-punitive running. According to Martin, residual (post-shock) emotionality is one factor which might contribute to an animal's motivational level in a massed-trial experiment but which should dissipate with the passage of time.

Martin trained rats to escape shock (1 ma) in an apparatus with a 1-ft white guillotine-doored startbox, white 4-ft alleyway, and black 1-ft goalbox. Following 32 massed (ITI 30 sec) escape trials, the animals were randomly assigned to one of the four groups comprising a 2 x 2 factorial design. One factor was punished vs. regular extinction and the other was delay vs. no-delay. Treatment of rats in the delay groups was identical to that in the no-delay groups except that the former were given an 18-min ITI between the 20th and 21st extinction trials. All rats were run 100 trials or until they failed to enter the goalbox within 60 sec on one trial. The nonpunished rats met the extinction criterion in an average of about 12 trials, thus few ran enough trials to receive the delay treatment. Of the punished rats, those with the 18-min delay averaged about 40 extinction trials, while those with no delay averaged more than 70. These differences were statistically significant. Running speed relationships followed those of the trials-to-extinction data. These results supported Martin's hypothesis that, in massed-trial self-punitive locomotor behavior experiments, residual shock-produced emotionality which presumably decreased during the 18-min "time-out" for rats in the delay groups, can be an important factor in the preservation of self-punitive running.

Beecroft and Fisher (1969) studied the effect of avoidable punishment during the extinction of an avoidance response. They used the typical 6-ft alleyway with bi-level startbox and dissimilar goalbox. Rats were given massed (ITI 60 sec) avoidance training with an CS-US interval of 3 sec until they made one successful avoidance. They were then administered regular extinction trials, punished extinction trials with shock in the last 2 ft of the alley, or punished extinction trials with shock in the last 2 ft of the alley beginning 2 sec after the start of each trial. All rats were run for 100 trials or until they failed to enter the goalbox within 60 sec. Punished rats completed more trials than unpunished rats, and those with delayed punishment completed more trials than those with immediate punishment. Beecroft noted that there are certain significant differences between the avoidance training procedure and the delayed-punishment extinction procedure. Only the former is known to support the acquisition of a forward locomotor response; failure to run leads to the onset of the US only in the avoidance procedure. In addition, the former seems to be better able to maintain forward locomotor responding since some rats given delayed punishment did extinguish in his experiment.

It should be noted that the results of Beecroft's experiment are quite consistent with the stimulus-similarity discrimination hypothesis. The delayed-punishment rats would have experienced less change in conditions from acquisition to extinction than rats with immediate punishment.

Delude, in 1969, published a provocative article in which he seriously questioned several of the procedures commonly used in self-punitive experiments and offered certain experimental data to support his position. He noted that in typical experiments the extinction criterion is failure to enter the goalbox, and the dependent variable is trials to extinction and/or running speed over trials. These running speed scores typically include "dummy" scores assigned rats for all trials after the trial on which they "extinguished." Delude proposed that failure to enter the goalbox is an inappropriate extinction criterion because the conditioned-fear interpretation relies on the rats' fear of the startbox. Dependent measures based on alley speeds would be biased in favor of the punished rats since their speeds would be facilitated if measured in or after the shock zone. Measurements dependent on speed prior to the shock zone could also be influenced by the typical extinction criterion and "dummy" score procedure since rats which fail to enter the goalbox on one trial might possibly continue to traverse the prepunishment zone on future trials, if given the opportunity to do so. Delude suggested that an extinction criterion based on preshock zone behavior, such as failure to leave the startbox, would be most appropriate.

In an experiment designed to compare performance under two extinction criteria Delude gave rats massed (ITI 30 sec) escape-training trials in a black 4-ft alley with a 1-ft black guillotine-doored startbox and 1-ft goalbox. The rats remained in the startbox for 3 sec prior to the beginning of each trial. Following acquisition, one group received regular extinction trials, one group punished extinction trials with shock in the 4-ft alley, and a third group shock in the startbox and first 3 feet of the alley. The two groups of interest were the regular and punished extinction groups. The punished rats took significantly more trials than the unpunished rats to reach the extinction criterion of failure to enter the goalbox within 30 sec, but did not differ from unpunished rats in trials to reach the extinction criterion of failure to leave the startbox within 30 sec. Although the punished animals ran faster on the last 10 trials prior to reaching the goalbox extinction criterion than the unpunished rats, no differences were found in startbox latencies for the 10 trials prior to the rats' reaching the startbox extinction criterion. In addition, he noted that on the trial on which each rat met the goalbox extinction criterion the unpunished rats left the startbox _faster_ than the punished rats.

Delude interpreted these results as demonstrating both punishment-produced facilitation and punishment-produced suppression, depending upon the response measure employed. He proposed that dependent measures based on a subject's latency or probability of leaving the startbox would be most appropriate for these studies since such measures would be more directly applicable to the conditioned-fear interpretation. Such measures, however, demonstrate either no differences between unpunished and punished rats, or poorer performance for the punished rats. He attributed the failure to attain even more suppressive effects to the rat's failure to discriminate between acquisition and extinction conditions, a cognitive discrimination notion. One should note, of course, that the complete Mowrer-Brown interpretation is more extensive than that addressed by Delude. It includes reference to startbox fear, prepunishment fear, reinstatement of tactual cues for running, possible shock-produced perseverative emotionality, primary reinforcement by shock offset for running during punished extinction, and secondary reinforcement upon entering the dissimilar (and presumably less fear-arousing) goalbox. Delude's emphasis on the rat's performance in the startbox alone would not seem properly to address the entire Mowrer-Brown theory of self-punitive behavior but does pose interesting questions and challenges to those working in the area.

In 1969, Brown published a comprehensive review of the literature on self-punitive locomotor behavior, including most of the published studies in this area up through the middle of 1968. His review provided, for the first time, a comprehensive discussion of self-punitive behavior including both empirical studies addressing the multitude of factors affecting such behavior, and the several theoretical developments designed to explain it. In addition, he included a section in which he provided a detailed list of factors thought to affect self-punitive behavior. Because the summary presented in the introduction (above) indicated relationships thought to be important for the demonstration of self-punitive responding (based on the research literature through 1974) no attempt will be made to detail these variables at this time.

Four papers in 1970 dealt with self-punitive locomotor behavior. The first extended the species in which the phenomenon is known to occur to include Mongolian Gerbils, the second dealt with added facilitation of extinction performance by a noxious noise presented concurrently with shock during punished extinction, the third was concerned with the effects on self-punitive behavior of the extinction of fear to the startbox cues following acquisition training, and the fourth dealt with the cognitive discrimination hypothesis.

In the first experiment Martin, Ragland, and Melvin (1970) gave 23-hr food deprived Mongolian Gerbils 35 shock-escape (1 ma) massed (ITI of 30 sec) training trials in an apparatus with a 12-in. white startbox, an 82-in. white alley, and a 12-in. black goalbox. The startbox, alley and goalbox were separated by guillotine doors. Following acquisition, half of the gerbils received regular extinction trials while the other half received punished extinction trials with shock in the first 13 in. of the alleyway. The gerbils were run for 100 trials or until they failed to reach the goalbox within 60 sec. Punished gerbils completed, on the average, about 50 extinction trials, whereas unpunished gerbils averaged about 22. Full alley running speeds reflected this relation also. Martin et al. suggested that better performance might have been obtained had the "rat" alley they used been shortened and more in proportion to the gerbil's smaller size, and had a depilatory been used to remove the hair from the gerbil's feet.

In the second study, Rollins and Melvin (1970) trained rats to escape 50-v shock in a 4-ft alleyway with bi-level startbox and dissimilar goalbox. Immediately following massed escape training (ITI about 60 sec) one group of rats was given regular extinction trials, one group punished extinction trials with shock in the first 2 ft of the alley, and a third group a shock + noise treatment. Animals in the latter group were given 15 normal punished extinction trials. Thereafter, in addition to shock in the first 2 ft of the alley, a noxious 101 dB noise began if the rat entered the alley, and terminated 0.40 sec later. All rats were run 60 trials or until they failed to enter the goalbox within 60 sec. Subjects in both punished groups ran significantly more trials and at higher speeds than the unpunished rats. While the punished groups did not differ on the first 15 extinction trials (on which the groups received identical no-noise treatment) the alley speeds of rats punished with shock and noise were significantly higher on the following trials than those of the shock-punished rats. Rollins and Melvin noted that these results were related to those of studies demonstrating cross-modal facilitation effects (Melvin & Martin, 1966) and also appeared to be like those of studies where increases in punishment intensities led to increased running speeds during punished extinction. Extinction conditions for rats in the shock + noise group were more unlike acquisition conditions than extinction conditions for those in the group punished with shock alone. One might have expected from a stimulus-similarity hypothesis, therefore, that the former group would do less well than the latter. Their results, however, were in the opposite direction, and would support interpretations such as the Mowrer-Brown theory, which include such factors as drive increments due to the presentation of external stimuli.

In the third study O'Neil, Skeen, and Ryan (1970) directly addressed the conditioned fear portion of the Mowrer-Brown interpretation of self-punitive locomotor behavior. Following 20 spaced (ITI 9-11 min) escape trials in a 4-ft alley with bi-level startbox and dissimilar goalbox the rats were assigned to one of the six groups of a 2 x 3 factorial design. One factor was punished vs. regular extinction whereas the other was number of fear extinction trials in the startbox. For one set of rats the first 16 extinction trials were fear extinction trials on which they were confined to the startbox for 30 sec after which they were released and allowed to traverse the alleyway and enter the goalbox. For a second set the first 8 trials were confinement trials, for the third set no confinement trials were given. For animals in the punished groups shock was present in the first 1 ft of the alleyway on the confinement and later extinction trials. All rats were run until they failed to enter the goalbox in 60 sec or completed 84 extinction trials following their confinement treatment. The rats which received no fear-extinction trials both ran and left the startbox faster than those that had received the confinement trials. Those confined for 8 trials ran faster than those confined for 16 trials but left the startbox more slowly. Punished rats ran faster than nonpunished rats in all groups, and punished rats in the 0- and 8-sec groups left the startbox faster than nonpunished controls. Of those confined for 16 trials, rats extinguished with shock left the startbox more slowly than those given no-shock extinction. Although the main effects in each instance were significant, follow-up tests for the individual comparisons were not reported. The authors indicated that their results were in agreement with the conditioned-fear portion of the Mowrer-Brown hypothesis since procedures thought to lead to the extinction of fear to the startbox cues reduced performance for all groups, and appeared to decrease self-punitive behavior for the punished animals.

Brown (1970) performed two studies dealing with the notion that rats run self-punitively because they fail to discriminate between the non-electrified preshock regions of the alley and the electrified areas (Mowrer, 1960; Delude, 1969). In his first experiment he gave his rats 21 shaping and escape (40-55 v) trials in a 6-ft gray runway with gray bi-level startbox and black goalbox. Ten spaced (ITI 8 min) trials were given each day except on the first extinction day on which one "booster" escape trial preceded the extinction trial. During extinction, half of the subjects were not punished and half encountered shock in the middle 2-ft section of the alley. For half the rats in each of these groups the color of the alley walls remained unchanged. For the other half, those in the "cue" groups, the walls of the middle 2-ft section were covered with black- and white-striped panels. The rats were run until they completed 60 extinction trials or until they failed to enter the goalbox within 60 sec. The typical punishment-produced facilitation effect was demonstrated; punished rats ran faster than nonpunished rats in the shock and postshock segments. Although punished rats in the cue group ran faster in the shock segment than punished rats in the group without the cue, the difference was not reliable.

In a second experiment similar procedures were used except that the type of cue provided to mark off the middle section of the alley was changed. During extinction, rather than having black- and white-striped walls in the middle 2-ft segment, Masonite flooring was placed over the grid floor in the startbox, and in the first and third sections of the alley. The middle 2-ft grid section remained uncovered. Again punished rats ran faster than nonpunished controls, this time in the preshock first segment, as well as in the shock and postshock segments. The punished rats with the cue ran faster than those without the cue, an effect which approached significance $(.10 < p < .05)$. Brown interpreted these results as being in contradiction to a theory stressing the ability of an organism to determine the location of shock during punished extinction because rats provided with cues to the location of the shock-zone did not run slower than those without the cue. In addition, he noted that there is no commonly accepted criterion for determining whether a rat has indeed discriminated the shock zone, other than that the rat extinguishes, the result that a cognitive discrimination hypothesis purports to explain. He pointed out that rats in the punishment-cue group sometimes stopped just in front of the shock zone, and then leaped forward over a portion of the exposed grid. Despite their seeming "discrimination" of the shock zone location, however, punished-cue rats had faster middle section speed scores than punished rats without the cue, and ran faster at the end of extinction than at the beginning. Such a result hardly seems consistent with a cognitive discrimination hypothesis.

In 1971 Brown, Beier, and Lewis published a paper which was an extension of the Brown (1970) studies. Their procedure and apparatus were very similar to those used by Brown (1970) in his second experiment. Like Brown, they trained rats to escape shock and then instituted punished or nonpunished extinction conditions, with or without the black Masonite flooring to make the middle 2-ft segment more salient. In this experiment, however, careful note was made of the rats making forward leaps of 15 cm or more which began in the preshock segment of the alley. This was then used as an indication of the extent to which a rat "discriminated" the location of the shock-segment. They found the typical results; the unpunished rats ran slower than the punished rats in all segments. In this experiment, however, the punished rats with cues ran slower than punished rats without cues, in the first segment, but did not differ from punished rats without cues in the second or third segment. Whereas 34 of the 40 rats in the cue groups made at least one leap of 15 cm or more in the preshock segment, only 1 of the 37 rats in the groups without the cue did so. In addition, of the rats given the cue, the median number of such leaps on the first three days of extinction was 6.5 for the punished rats, and 1.5 for nonpunished rats. Brown et al. interpreted these results as being incompatible with a cognitive discrimination hypothesis, provided the rats' leaping behavior prior to the shock zone could be used as an independent determinant that the rats discriminated the location of the shock. While punished rats which received the cue to the shock location would seem to have clearly discriminated its location, as evidenced by their forward leaping behavior, they ran significantly faster toward, over, and after leaving the electrified middle segment than nonpunished rats. Such results fail to support a cognitive discrimination hypothesis which holds that punished rats run in self-punitive locomotor behavior experiments because they are unable to distinguish the presence or absence of shock in different portions of the alleyway.

Siegal, Melvin, and Wagner (1971) reported an experiment addressing Delude's (1969) comments on the use of dependent measures and extinction criteria based on prepunishment behavior. In their investigation, two groups of rats were given massed (ITI 45 sec) escape training and extinction in a 4-ft white alley with bi-level startbox and black goalbox. Half of the animals were not shocked during extinction; the other half were punished in the second 1 ft of the alley on 2/3rds of the extinction trials. All rats were run for 75 trials or until they failed to leave the prepunishment section of the alley within 30 sec. Punished subjects ran faster than nonpunished controls on the third of the extinction trials on which no shock was present in the alley, and, over all trials, in the prepunishment sections of the alley. In addition, reliably more nonpunished rats met the extinction criterion than punished rats. Siegel et al., were thus able to demonstrate the facilitative effect of punishment using dependent measures and an extinction criterion which would not have been directly affected by any dynamogenic effects of shock. Apparently, demonstrations of the facilitating effects of shock are not limited to the conditions to which Delude objected and which are commonly employed in self-punitive behavior experiments.

In the same year Babb and Hom (1971) reported a study in which goal shock during extinction facilitated locomotor behavior acquired under three different training regimens. Initially, rats were given either escape, partial-avoidance (with a 1 sec CS-US interval), or avoidance training (with a 3 sec CS-US interval) in a 4-ft gray alleyway with 1-ft gray startbox, and 1-ft gray goalbox. Following five spaced (ITI 6 min) acquisition trials per day for six days, extinction conditions were implemented. Half of the animals in each group were not shocked, while the other half were given 0.5-sec, 1.0 ma shocks as they entered the goalbox. On each trial a 78-dB buzzer was turned on as the startbox guillotine door was raised and ceased as the goalbox guillotine door was lowered. Rats were run until they failed, on three successive trials on the same day, to leave the startbox within 60 sec and to leave the alleyway within 180 sec. During extinction there were no differences in startbox latencies between escape-trained punished and nonpunished rats. The avoidance-trained punished rats left the startbox faster than the unpunished rats while unpunished subjects trained with partial-avoidance left the startbox faster than their punished counterparts. Full alley running speeds were also reported Punished rats in both the escape and avoidance groups ran faster than their nonpunished counterparts, but punished and nonpunished partial-avoidance rats did not differ. There were no differences in terms of trials to extinction. The authors indicated that these results were in agreement with Bender and Melvin's (1967) study of self-punitive behavior following escape and avoidance training, but inconsistent with that of Beecroft and Brown (1967). As previously mentioned, however, interpretation of the findings of the latter study is difficult since there were no nonpunished control groups. Babb and

Hom also noted that the results of their experiment were relevant to Delude's (1969) comments on self-punitive locomotor behavior because they demonstrated the facilitating effect of punishment in both the startbox and alley, both of which were prepunishment measures, and used a procedure which reduced any possible bias provided by choice of extinction criterion. Their results, however, were in agreement with an extended conditioned-fear theory. Because goal punishment immediately followed exposure to startbox and alleyway cues, because the goalbox was the same color as the alley and startbox, and because the explicit CS overlapped the onset of the punishing shock, the cues of the startbox and alley cues, as well as the explicit CS, should have acquired fear-arousing properties. Such cues could motivate, and by their offset reinforce, forward locomotion. Because the shock duration was so brief, the rats may have still been moving forward into the goalbox when the shock ceased. Thus, forward locomotion could have been primarily reinforced by shock offset. In addition, since the rats were allowed to remain in the goalbox for 29.5 sec following the offset of shock, they would have been exposed to a long period of safety in the goalbox following each trial.

In 1971 Dreyer and Renner published an interesting paper in which they championed a cognitive discrimination or "confusion" interpretation of self-punitive behavior. They suggested that the cognitive discrimination hypothesis could prove viable in spite of the experiments in which better performance was demonstrated by rats having greater change from acquisition to extinction conditions than by those with smaller change (Melvin, 1964; Martin & Melvin, 1966). Brown's (1970) experiments, and that of Brown, Beier, and Lewis (1971) were not available to Dryer and Renner at the time they wrote their paper. They suggested that only those changes which affect a discrimination between acquisition and extinction conditions are important. They inferred from the extinction of the punished rats that they finally discriminated that there was no longer shock in the startbox, and that rats that have not extinguished have not made this discrimination. In addition, they rejected Brown's extension of self-punitive animal data to human masochism (Brown, 1965). They stated that Brown's suggestion that punished rats choose to run from the "safe" startbox into shock, and then to the goalbox, was incorrect because these rats might not "know" that shock is no longer present in the startbox. To make statements about an organism's choice one must know something of the organism's expectencies and preferences. Since there is no easy way to know whether a choice exists for the rat, in leaving the startbox, they suggested that Brown's interpretation is no less circular than the position which holds that rats which continue to demonstrate self-punitive behavior have not discriminated between shocked and non-shocked portions of the alley. Although this may well be correct, it should certainly be noted that the concept of choice is neither central to nor necessary for the Mowrer-Brown interpretation of self-punitive behavior. The concept of discrimination, however, is central to the cognitive discrimination hypothesis.

In support of their views they reported an experiment which, they suggested, offered a human analogue of the animal research. The human subjects were given escape training in which pulsating shock immediately followed a 0.5 sec buzzer. The subject could turn off the shock by pressing a telegraph key 180 times. Every 20 presses would advance a counter by 1. The shock began with the counter at 1 and ceased when the counter reached 10. After five such acquisition trials half of the subjects were assigned to a nonshock regular extinction group while the other half were assigned to a punished extinction group. For the punished subjects, no shock was presented unless they pressed the key once following the onset of the buzzer. If they did so they could escape shock by pressing the key 179 more times. Any subjects who had not extinguished by the end of five trials were told that pressing the key turned on the shock, and then given an additional trial. Their results indicated that punished subjects pressed the key more rapidly during extinction than did the nonpunished subjects. Speed of pressing was reduced markedly on the sixth trial, however, the trial after the subjects were told of the contingencies in effect during extinction. Only one punished subject continued to press. Dreyer and Renner suggested that their results were quite similar to those of the animal studies and demonstrated that the concepts of choice, preference, and masochism may be inappropriate when used in conjunction with self-punitive locomotor behavior animal studies since nonresponse, or failure to run, does not exist as a viable (known) alternative for punished rats. They concluded that there is no need to cast the cognitive discrimination hypothesis and Mowrer-Brown hypothesis as competing and mutually exclusive explanations. Instead, they said that these interpretations are complementary in that the cognitive discrimination hypothesis suggests that rats are fearful in the startbox since they haven't learned to discriminate the difference between the safe startbox and the alleyway where shock is present. To argue that the self-punitive locomotor behavior paradigm provides a subhuman analogue to human masochism, however, it would be necessary to show that for punished rats running to shock is preferred over some alternative, but that unpunished rats are indifferent to that alternative, or have some other preferred alternative. They concluded with the statement that such a demonstration seems unlikely.

Dreyer and Renner's suggestions and demonstration are difficult to reconcile with the studies by Brown (1970) and Brown, Beier, and Lewis (1971) in which attempts were made to facilitate rats' discrimination of the shocks' location. All three of these experiments failed to show any suppressive effect of punishment; in all cases shock led to facilitation or extinction performance, and in one case led to facilitation which was greater for the punished-cue than punished-no cue groups. These results are also inconsistent with a conditioned-fear interpretation stressing simultaneous conditioning of fear to the cues of the shock segment. Setting off the shock zone from the rest of the alley would have had the effect of making the cues of the shock zone more dissimilar to those of the prepunishment area than were the cues of the unmodified shock zone. Less fear, then, would be expected to generalize from the cues of the shock zone to those of the startbox, by the laws of stimulus generalization. An alternative interpretation would stress forward rather than simultaneous fear conditioning. When shock appears in the second segment of an alley it may not be the cues of that segment to which fear is conditioned with the greatest strength, but instead to the cues of the prepunishment sections. This latter interpretation would be consistent with the results of the distinctive shock-zone experiments.

In 1971 Melvin provided an updated review of the literature on self-punitive locomotor behavior and incorporated experiments demonstrating other types of vicious-circle behavior (bar pressing and chain pulling, etc.). Although his review of the locomotor behavior literature was not as detailed as Brown's, his work marked the first time that the many different types of experimentally-produced vicious-circle behavior had received detailed consideration in the same review. In addition, he added some interesting insights into the interpretation of the shock-zone location studies. His comments, and suggested improvements to the conditioned-fear theory, are discussed above in the summary of current theories of self-punitive behavior.

In 1972, Crowell, Brown, and Lewis published a study of self-punitive behavior using a successive discrimination procedure; one stimulus was presented on punished extinction trials, and another on regular extinction trials. Their animals were first given escape training in the 6-ft alley with bi-level startbox and dissimilar goalbox commonly used by Brown and his associates. Extinction trials followed 10 shaping, 10 escape, and one "booster" escape trial. Ten extinction trials were administered each day to each rat until 100 trials had been completed or until a rat failed to enter the goalbox within 60 sec. On each extinction trial a tone began 10 sec prior to the rat's being dropped from the upper level of the startbox to its lower level, and terminated when the rat left the second 2-ft section of the alley. One frequency was presented on the half of the trials on which shock was present in the alley, while a second frequency was presented on trials when no shock was present. Starting speeds, and running speeds in each of the three 2-ft segments of the alley, were significantly higher on shock than non-shock trials, thus demonstrating the self-punitive locomotor behavior effect using the within-subjects design. Since the animals behaved differentially to the two stimuli, and ran faster into the shocked region from the nonshock first section and startbox during presentations of the tone signalling the presence of the shock, Crowell, et al., argued that the rats were discriminating between shock and nonshock trials. Despite this "discrimination" they behaved "irrationally," and continued to run through the electrified middle alley segment for many trials. Although a nonpunished group was not provided, such a group might have been useful. Crowell et al. might then have demonstrated that their punished rats ran faster and/or for more trials than rats which received the tone presentations but were not shocked on any trials.

Delude (1973, 1974) and Delprato and Meltzer (1974) have recently reported experiments in which drop-starting and guillotine-door starting procedures were compared. Rats run with drop-starting procedures were dropped from the upper to the lower compartment of a bi-level startbox at the beginning of a trial. Those given trials with the guillotine-door procedure, on the other hand, were placed into a startbox separated from the alley by a guillotine-door, which was raised when the trial began. In three experiments in which these procedures were compared, punished rats extinguished with the drop-start procedure demonstrated typical punishment-produced response facilitation. Those extinguished with the guillotine-door procedure, however, either performed no differently from unpunished controls or displayed suppression of performance. A detailed discussion of these experiments has been presented above.

Walker, Williams, and Martin (1974) recently published a study dealing with the effects of "social interaction" on self-punitive behavior. In this study the authors explored the effects of the presence of a second rat in the alleyway during punished extinction. They suggested that the presence of the second rat might reduce self-punitive responding since such behavior is assumed to be fear-motivated. Latane (1968) and Latane and Glass (1969) demonstrated that the presence of another rat would reduce the amount of fear (freezing) shown by rats in a putatively fear-arousing situation (a strange place).

A portion of Walker et al.'s rats were given massed (ITI 30 sec) acquisition escape trials in a white 4-ft alley with a 1-ft white startbox and 1-ft black goalbox. Others received no acquisition trials. During extinction the rats were assigned to one of four groups. Rats in the first group encountered no shock in the alley while those in the second group encountered shock in the last 18 in. Rats in the third group, unlike those in the first two groups, were extinguished in pairs. Both rats in the pair had previously received escape training, and during extinction, encountered shock in the alley. Those in the fourth group were also run in pairs and received punished extinction trials. One of the rats in each pair, however, had not been given escape training.

The usual self-punitive effect was demonstrated; nonpunished rats ran significantly fewer trials during extinction than punished rats. In addition, the rats which were run in pairs ran significantly fewer trials than those run alone. The most important finding, however, was that the rats in the third group, which had both been given escape training, demonstrated significantly better extinction performance than those in the fourth group, where one rat in each pair was naive.

Because the comparison of the performance of rats in the third and fourth groups would not be confounded by differential stimulus generalization decrement due to the presence of the second rat in the alley, differences between the performance of rats in those two groups must be attributed to the difference in training received by rats in the two groups. Walker et al. interpreted their results as being due to the gregarious tendency of rats. Rats in the fourth group, which had been given escape training, would have been in a conflict situation during extinction. Tendencies to leave the startbox and alley quickly would have been in competition with the tendency to remain in the startbox or explore the alley with the naive rat. Of course, the physical impediment to forward locomotion offered by the naive rats' blocking the alley on some trials might also have accounted for these results. The authors interpreted the reduced performance of the escape-trained punished pair, compared to the punished rats run singly, as due to the decremented emotionality of the former rats as well as to their natural gregarious and investigatory behavior.
It should also be noted that the comparison of the punished rats run together to the nonpunished rats run singly would indicate that

punishment suppresses behavior. Such a comparison would not be justified, however. Appropriate comparison groups, similar to the third and fourth groups, but unpunished, were not included in the design. We cannot, therefore, say with any certainty what would be the effect of punishment during extinction of the locomotor performance of pairs of rats.

Klare reported (1974) a study in which he investigated the effects of postshock emotionality upon self-punitive behavior. In addition, he obtained an independent measure of fear during both acquisition and extinction by recording activity levels in the upper level of his bi-level starting chamber. He utilized a 2 x 2 x 2 x trials design. One factor was the presence or absence of shock in the middle section of the alley during extinction while the second was the administration of a short shock either prior to (preshock) or after (postshock) the one trial given each day. The third factor was the presence or absence of shock in the startbox and alley during acquisition, i.e. escape training vs. no-shock exploration trials. Acquisition and extinction trials were administered in a 6-ft alley with gray bi-level startbox and black goalbox. The pre- or post-trial shocks were given in a distinctive circular or triangular chamber, in an appropriately counter-balanced manner. During both acquisition and extinction each rat was placed into the pre-trial chamber for 95 sec. If the rat was in one of the preshock groups a 2-sec shock was administered 50-70 sec after the rat had been placed into the chamber. Ninety-five sec later the rat was removed from the pre-trial chamber and placed into the upper chamber of the bi-level startbox for 15 sec. After 10 sec, a buzzer CS

(9 dB above background) began; 5 sec later the trapdoor-floor of the upper compartment was released, dropping the rat into the lower start-box to begin the single trial of the day. After each trial each rat remained in the goalbox 20 sec. If a rat failed to enter the goalbox within 60 sec it was removed from the alley and placed in the goalbox for 20 sec. Immediately after removal from the goalbox each rat was put into the post-trial chamber for 95 sec, where it received a 2-sec shock if assigned to one of the postshock groups. Each rat received 15 acquisition trials and 30 extinction trials.

During acquisition, the escape-trained groups did not differ in either full-alley speed or upper startbox activity. Escape-trained rats, however, were significantly less active than rats given exploration-only trials. During extinction the escape-trained rats again had reliably lower activity levels than rats given only exploration trials. Of the escape-trained rats those given punished extinction trials had lower activity levels than those given regular extinction trials. The inverse was true of these rats' running speeds; punished rats ran faster than nonpunished rats. In addition, punished, preshocked rats ran slower than punished, postshocked rats. Finally, the startbox latencies and first segment running speeds were lower for escape-trained punished rats than escape-trained nonpunished rats on initial extinction trials but higher on later trials. Klare argued that he had demonstrated the typical self-punitive phenomenon using a design in which the possible motivating (and therefore confounding) effects of postshock emotionality were controlled. In addition, using an independent measure of fear (freezing) he supported a major contention of the Mowrer-Brown theory of self-punitive behavior, that punished animals are more fearful in the startbox than those that are not punished.

Finally, he demonstrated that shock presented a short time prior to an extinction trial, and presumably capable of arousing postshock emotionality, hindered rather than facilitated running during extinction. He also cited data to counter the possible argument that decreased activity was due to the rats' learning a crouching response in preparation for the release of the trapdoor-floor; the activity levels increased rather than decreased during the 15 sec the rats spent in the startbox.

Kruger (1974) reported an experiment similar to those of Melvin and Stenmark (1968) and Galvani (1969). Rats were given fear conditioning trials followed by regular or punished extinction trials. Kruger used a 4-ft gray alley with gray bi-level startbox and black goalbox. He gave 10 buzzer-shock pairings to three groups and 10 buzzer alone presentations to a fourth group. The shock intensities were 40, 53, or 70 v, for members of the first, second, and third groups, respectively. The CS-US interval was 6 sec whereas the ITI averaged 60 sec. These four pre-extinction treatments were combined factorially with four extinction-trial treatments. On extinction trials, given at an ITI of 60 sec, some animals encountered no shock while others encountered shock of 40, 53, or 70 v in the third and fourth foot of the alley. Extinction trials were administered until 60 trials were completed or until the animal failed to enter the goalbox within 60 sec.

Both the number of extinction trials completed and prepunishment running speed were found to be a function of the intensity of the shock on fear conditioning trials, but not on punishment trials. Punishment-produced facilitation was observed, however, in terms of shock-segment running speeds. Kruger suggested that his results offered some support for a conditioned-fear interpretation of self-punitive locomotor behavior because extinction performance was positively related to the intensity of the US for fear conditioning. Further, his demonstration of self-punitive behavior (in terms of shock segment speeds) suggested that the self-punitive effect need not be limited to previously learned responses.

Finally, Cunningham, Brown, and Roberts (1975), in an unpublished study, manipulated confinement time in the upper compartment of a bi-level startbox before each trial, and goalbox confinement time after each trial, in a 2 x 2 x 2 x trials factorial design. In both the upper holding compartment and goalbox the short confinement durations were 5 sec and the long confinement durations were 60 sec. Each rat was handled the same number of times, twice, and at the same time before each trial, 60 sec and 5 sec, regardless of its group assignment. Thus, associative-motivational properties of the handling procedure were equated between groups. The apparatus was a 6-ft long gray alley with a gray bi-level startbox and black and white checkered goalbox. All animals were given 12 shock escape trials (40-60 v), one per day. One of the four possible combinations of pretrial confinement time and goalbox confinement time was used on each trial. At the end of acquisition each rat had been run three trials with each of the four combinations. The rats were then assigned to one of the four treatment groups and given all extinction trials with one of the four possible combinations of pretrial and goalbox time. Half of the subjects in each of these treatment groups were given nonpunished extinction trials while the other half were given punished extinction trials on which they encountered shock (50 v) in the middle segment of the alley. All rats were run for 30 trials, 1 per day, or until they failed to enter the goalbox within 60 sec on 2 consecutive trials.

Prepunishment speeds were greater for punished than nonpunished animals in the 5-sec pretrial-confined groups, but nonpunished controls were faster than punished rats in the 60-sec pretrial-confined groups. Goalbox confinement time did not prove to be a significant determinant of prepunishment behavior. Trials to extinction data were not analyzed.

The authors interpreted their results as offering support for the conditioned-fear interpretation of self-punitive behavior because a manipulation assumed to lead to the extinction of fear, long upper holding area confinement, reduced extinction performance, in general, and led to punishment-produced suppression of extinction responding. Shorter pretrial confinements, on the other hand, would limit extinction of fear, and permit relatively strong extinction performance and punishment-produced facilitation, both of which were noted in their experiment. Little evidence was obtained, however, to support the notion that duration of fear reduction <u>in the goalbox</u> is an important factor in determining the effect of punishment on extinction behavior.

A general summary of the empirical evidence for self-punitive locomotor behavior, as well as a discussion of the theories espoused to explain these data, is provided in the Introduction beginning on p. 2.

APPENDIX B

Mean starting scores (multiplied by 10) and mean running speeds (in cm/sec) averaged over the four trials each day for each subject in each group with each extinction criterion in every experiment.

EXPERIMENT 1

MEAN STARTING SCORES OF 1-SEC SUBJECTS
GIVEN MODIFIED-CONVENTIONAL HANDLING

GOALBOX
CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	19.8	30.6	17.7	0.7	0.7	0.7	0.7	0.7
2	6.4	24.5	27.1	9.6	0.7	0.7	0.7	0.7
3	8.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	1.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
5	0.8	1.0	0.9	5.5	5.4	0.8	0.7	0.7
6	2.6	2.9	9.0	5.6	1.8	1.1	0.7	0.7
7	19.6	21.9	0.7	0.7	0.7	0.7	0.7	0.7
8	8.1	8.0	8.9	12.3	13.7	14.8	0.7	0.7
9	4.8	8.7	9.8	0.7	0.7	0.7	0.7	0.7

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	25.8	14.9	17.8	11.0	20.9	15.2	9.5	10.6
2	2.8	2.7	0.8	0.7	0.7	0.7	0.7	0.7
3	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	1.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7
5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
6	11.8	18.0	23.4	15.4	10.8	0.7	0.7	0.7
7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
8	7.8	11.4	10.7	9.4	6.0	7.7	5.9	4.1
9	11.3	10.9	12.9	12.4	11.6	12.7	11.0	8.3

EXPERIMENT 1

MEAN STARTING SCORES OF 1-SEC SUBJECTS GIVEN CONTROLLED HANDLING

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	15.4	18.7	17.4	10.9	15.5	0.7	0.7	0.7
2	9.2	4.8	3.2	0.7	0.7	0.7	0.7	0.7
3	6.5	8.0	20.7	12.1	3.9	0.7	0.7	0.7
4	23.7	26.5	28.0	20.8	23.4	8.3	0.7	0.7
5	2.0	5.0	5.5	13.0	1.4	4.6	4.2	3.3
6	1.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7
7	8.7	4.1	8.0	5.4	9.5	7.2	4.6	17.0
8	1.7	6.5	3.6	9.2	8.8	10.5	11.1	10.8
9	6.4	8.1	9.9	9.2	6.8	4.2	4.9	4.3

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	27.4	20.1	11.2	13.4	13.2	12.3	0.7	0.7
2	13.4	11.2	10.8	8.2	3.1	1.2	1.2	1.5
3	6.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	28.1	28.9	26.0	25.7	25.5	11.9	4.9	0.7
5	1.8	1.5	0.7	0.7	0.7	0.7	0.7	0.7
6	10.4	1.1	0.9	0.8	0.7	0.7	0.7	0.7
7	1.2	1.9	3.1	10.0	5.3	1.2	0.7	0.7
8	6.2	7.7	5.8	0.7	0.7	0.7	0.7	0.7
9	11.9	9.5	8.8	10.0	3.0	8.7	11.3	10.2

EXPERIMENT 1

MEAN STARTING SCORES OF 16-SEC SUBJECTS GIVEN MODIFIED CONVENTIONAL HANDLING

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	8.1	8.7	6.9	6.4	4.6	9.4	5.2	0.7
2	1.4	0.9	0.7	0.7	0.7	0.7	0.7	0.7
3	5.9	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	29.8	37.3	36.2	16.9	29.7	0.7	0.7	0.7
5	3.6	2.5	4.0	6.4	1.7	0.7	0.7	0.7
6	5.4	4.7	6.1	0.7	0.7	0.7	0.7	0.7
7	8.6	1.1	0.8	0.7	0.7	0.7	0.7	0.7
8	10.5	12.1	12.0	4.1	0.7	0.7	0.7	0.7
9	3.7	0.9	0.7	0.7	0.7	0.7	0.7	0.7

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	15.6	17.0	0.7	0.7	0.7	0.7	0.7	0.7
2	3.3	14.6	1.8	0.7	0.7	0.7	0.7	0.7
3	3.0	8.0	18.0	3.0	6.1	1.0	2.9	1.0
4	1.1	0.7	0.7	0.7	0.7	0.7	0.7	0.7
5	1.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7
6	4.3	0.8	0.7	0.7	0.7	0.7	0.7	0.7
7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
8	3.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7
9	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7

EXPERIMENT I

MEAN STARTING SCORES OF 10-SEC SUBJECTS GIVEN CONTROLLED HANDLING

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	4.0	3.3	7.6	0.7	0.7	0.7	0.7	0.7
2	13.7	5.2	13.3	12.7	4.9	16.1	10.4	14.7
3	14.7	15.1	11.0	1.0	0.7	0.7	0.7	0.7
4	6.5	7.4	8.3	12.5	6.1	0.7	0.7	0.7
5	18.1	19.0	18.3	24.2	22.6	16.9	0.7	0.7
6	10.3	12.5	10.9	7.3	0.7	0.7	0.7	0.7
7	15.3	14.4	1.4	0.7	0.7	0.7	0.7	0.7
8	1.0	0.7	0.7	0.7	0.7	0.7	0.7	0.7
9	9.8	10.6	0.7	0.7	0.7	0.7	0.7	0.7

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	13.2	7.6	20.8	14.7	8.7	0.7	0.7	0.7
2	13.2	19.4	4.1	0.7	0.7	0.7	0.7	0.7
3	5.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	6.3	10.9	15.2	12.8	12.3	12.9	3.1	0.7
5	25.0	8.2	0.7	0.7	0.7	0.7	0.7	0.7
6	29.9	23.4	18.9	19.1	0.7	0.7	0.7	0.7
7	4.7	0.9	0.7	0.7	0.7	0.7	0.7	0.7
8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
9	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7

EXPERIMENT 1

GOALBOX CRITERION

MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 1-SEC SUBJECTS GIVEN MODIFIED-CONVENTIONAL HANDLING

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	48.0	28.0	18.0	4.0	4.0	4.0	4.0	4.0
2	64.0	76.0	91.0	51.0	4.0	4.0	4.0	4.0
3	115.0	26.0	4.0	4.0	4.0	4.0	4.0	4.0
4	35.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	150.0	146.0	109.0	31.0	17.0	10.0	4.0	4.0
6	146.0	112.0	92.0	51.0	55.0	43.0	4.0	4.0
7	148.0	133.0	20.0	4.0	4.0	4.0	4.0	4.0
8	79.0	35.0	24.0	29.0	22.0	14.0	4.0	4.0
9	89.0	67.0	50.0	4.0	4.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	97.0	90.0	109.0	133.0	110.0	125.0	145.0	142.0
2	98.0	118.0	61.0	4.0	4.0	4.0	4.0	4.0
3	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	109.0	12.0	4.0	4.0	4.0	4.0	4.0	4.0
5	39.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
6	46.0	93.0	101.0	62.0	28.0	4.0	4.0	4.0
7	56.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
8	118.0	132.0	120.0	132.0	141.0	140.0	153.0	128.0
9	100.0	102.0	106.0	115.0	118.0	119.0	109.0	121.0

EXPERIMENT 1 MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 1-SEC SUBJECTS GIVEN CONTROLLED HANDLING

GOALBOX CRITERION

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	111.0	104.0	102.0	99.0	83.0	19.0	4.0	4.0
2	37.0	5.0	19.0	4.0	4.0	4.0	4.0	4.0
3	108.0	62.0	88.0	60.0	6.0	4.0	4.0	4.0
4	66.0	64.0	38.0	40.0	32.0	6.0	4.0	4.0
5	92.0	95.0	41.0	4.0	4.0	4.0	4.0	4.0
6	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	141.0	138.0	124.0	45.0	56.0	35.0	17.0	39.0
8	103.0	63.0	24.0	43.0	30.0	21.0	22.0	4.0
9	89.0	93.0	97.0	87.0	4.0	4.0	4.0	4.0

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	136.0	92.0	127.0	143.0	138.0	109.0	116.0	14.0
2	105.0	86.0	133.0	131.0	131.0	122.0	65.0	105.0
3	107.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	92.0	91.0	84.0	76.0	68.0	79.0	17.0	18.0
5	19.0	15.0	4.0	4.0	4.0	4.0	4.0	4.0
6	153.0	182.0	189.0	172.0	161.0	168.0	4.0	4.0
7	86.0	121.0	88.0	139.0	76.0	159.0	167.0	4.0
8	139.0	143.0	136.0	4.0	4.0	4.0	4.0	4.0
9	104.0	122.0	120.0	91.0	62.0	113.0	123.0	130.0

EXPERIMENT 1 — MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 16-SEC SUBJECTS GIVEN MODIFIED-CONVENTIONAL HANDLING

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	85.0	40.0	22.0	17.0	8.0	5.0	4.0	4.0
2	14.0	7.0	4.0	4.0	4.0	4.0	4.0	4.0
3	20.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	34.0	24.0	15.0	23.0	20.0	4.0	4.0	4.0
5	115.0	57.0	21.0	13.0	10.0	4.0	4.0	4.0
6	78.0	18.0	13.0	4.0	4.0	4.0	4.0	4.0
7	93.0	28.0	4.0	4.0	4.0	4.0	4.0	4.0
8	70.0	38.0	22.0	9.0	4.0	4.0	4.0	4.0
9	99.0	6.0	4.0	4.0	4.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	74.0	44.0	4.0	4.0	4.0	4.0	4.0	4.0
2	57.0	51.0	5.0	4.0	4.0	4.0	4.0	4.0
3	124.0	134.0	143.0	155.0	152.0	135.0	165.0	116.0
4	35.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	30.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
6	60.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	26.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
8	26.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
9	26.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0

EXPERIMENT 1

MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 16-SEC SUBJECTS GIVEN CONTROLLED HANDLING

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	57.0	42.0	53.0	4.0	4.0	4.0	4.0	4.0
2	88.0	72.0	48.0	24.0	83.0	31.0	13.0	31.0
3	69.0	14.0	12.0	4.0	4.0	4.0	4.0	4.0
4	81.0	27.0	40.0	27.0	26.0	4.0	4.0	4.0
5	118.0	109.0	57.0	44.0	32.0	23.0	4.0	4.0
6	14.0	58.0	38.0	25.0	4.0	4.0	4.0	4.0
7	10.0	16.0	4.0	4.0	4.0	4.0	4.0	4.0
8	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
9	33.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	75.0	102.0	94.0	92.0	56.0	4.0	4.0	4.0
2	47.0	47.0	19.0	4.0	4.0	4.0	4.0	4.0
3	30.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	91.0	97.0	122.0	73.0	114.0	128.0	39.0	4.0
5	56.0	38.0	4.0	4.0	4.0	4.0	4.0	4.0
6	87.0	101.0	110.0	68.0	4.0	4.0	4.0	4.0
7	43.0	6.0	4.0	4.0	4.0	4.0	4.0	4.0
8	27.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
9	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0

EXPERIMENT 1 MEAN THIRD SEGMENT (POSTPUNISHMENT) SPEEDS OF 1-SEC SUBJECTS GIVEN MODIFIED-CONVENTIONAL HANDLING

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	67.0	67.0	31.0	13.0	4.0	4.0	4.0	4.0
2	43.0	52.0	68.0	4.0	4.0	4.0	4.0	4.0
3	42.0	13.0	4.0	4.0	4.0	4.0	4.0	4.0
4	22.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	161.0	139.0	151.0	26.0	32.0	9.0	4.0	4.0
6	159.0	149.0	160.0	131.0	98.0	45.0	4.0	4.0
7	128.0	125.0	32.0	4.0	4.0	4.0	4.0	4.0
8	30.0	4.0	22.0	23.0	14.0	11.0	4.0	4.0
9	44.0	33.0	28.0	4.0	4.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	90.0	107.0	102.0	107.0	66.0	73.0	90.0	84.0
2	107.0	114.0	112.0	25.0	4.0	4.0	4.0	4.0
3	25.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	72.0	23.0	4.0	4.0	4.0	4.0	4.0	4.0
5	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
6	45.0	73.0	125.0	49.0	21.0	4.0	4.0	4.0
7	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
8	54.0	66.0	67.0	69.0	22.0	55.0	63.0	48.0
9	85.0	91.0	86.0	97.0	90.0	103.0	106.0	94.0

EXPERIMENT 1

MEAN THIRD SEGMENT (POSTPUNISHMENT) SPEEDS OF 1-SEC SUBJECTS GIVEN CONTROLLED HANDLING

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	92.0	68.0	48.0	60.0	59.0	4.0	4.0	4.0
2	39.0	32.0	38.0	4.0	4.0	4.0	4.0	4.0
3	65.0	54.0	42.0	25.0	13.0	4.0	4.0	4.0
4	59.0	59.0	44.0	24.0	17.0	11.0	4.0	4.0
5	85.0	69.0	4.0	4.0	4.0	4.0	4.0	4.0
6	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	124.0	102.0	112.0	58.0	32.0	56.0	52.0	45.0
8	28.0	36.0	19.0	32.0	16.0	21.0	32.0	12.0
9	47.0	25.0	27.0	32.0	25.0	32.0	25.0	29.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	152.0	150.0	143.0	144.0	139.0	139.0	130.0	87.0
2	121.0	110.0	113.0	111.0	99.0	104.0	113.0	106.0
3	103.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	101.0	105.0	75.0	52.0	77.0	77.0	52.0	4.0
5	55.0	46.0	4.0	4.0	4.0	4.0	4.0	4.0
6	125.0	171.0	176.0	165.0	141.0	176.0	4.0	4.0
7	135.0	132.0	133.0	144.0	129.0	141.0	148.0	4.0
8	85.0	94.0	65.0	4.0	4.0	4.0	4.0	4.0
9	46.0	60.0	61.0	67.0	66.0	70.0	78.0	76.0

EXPERIMENT 1 — MEAN THIRD SEGMENT (POSTPUNISHMENT) SPEEDS OF 16-SEC SUBJECTS GIVEN MODIFIED-CONVENTIONAL HANDLING

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	80.0	51.0	39.0	32.0	24.0	23.0	9.0	4.0
2	19.0	26.0	4.0	4.0	4.0	4.0	4.0	4.0
3	18.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	21.0	23.0	35.0	4.0	4.0	4.0	4.0	4.0
5	56.0	43.0	38.0	21.0	7.0	4.0	4.0	4.0
6	124.0	22.0	18.0	4.0	4.0	4.0	4.0	4.0
7	113.0	24.0	29.0	4.0	4.0	4.0	4.0	4.0
8	45.0	26.0	23.0	9.0	4.0	4.0	4.0	4.0
9	42.0	7.0	4.0	4.0	4.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	98.0	56.0	4.0	4.0	4.0	4.0	4.0	4.0
2	81.0	33.0	28.0	4.0	4.0	4.0	4.0	4.0
3	142.0	157.0	156.0	157.0	149.0	135.0	197.0	134.0
4	40.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	18.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
6	50.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
8	63.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
9	68.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0

EXPERIMENT 1 MEAN THIRD SEGMENT (POSTPUNISHMENT) SPEEDS OF 16-SEC SUBJECTS GIVEN CONTROLLED HANDLING

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	21.0	31.0	40.0	73.0	4.0	4.0	4.0	4.0
2	73.0	65.0	25.0	50.0	45.0	40.0	18.0	28.0
3	35.0	40.0	33.0	4.0	4.0	4.0	4.0	4.0
4	45.0	60.0	49.0	60.0	23.0	4.0	4.0	4.0
5	125.0	101.0	64.0	86.0	22.0	25.0	4.0	4.0
6	23.0	59.0	29.0	25.0	4.0	4.0	4.0	4.0
7	19.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0
8	13.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
9	47.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	109.0	137.0	153.0	136.0	129.0	4.0	4.0	4.0
2	69.0	81.0	68.0	4.0	4.0	4.0	4.0	4.0
3	54.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	97.0	110.0	114.0	58.0	99.0	132.0	38.0	4.0
5	120.0	96.0	4.0	4.0	4.0	4.0	4.0	4.0
6	95.0	115.0	145.0	126.0	4.0	4.0	4.0	4.0
7	40.0	11.0	4.0	4.0	4.0	4.0	4.0	4.0
8	6.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
9	7.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0

EXPERIMENT 1

MEAN STARTING SCORES OF 1-SEC SUBJECTS GIVEN MODIFIED CONVENTIONAL HANDLING

PREPUNISHMENT CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	19.8	30.6	17.7	4.7	0.7	0.7	0.7	0.7
2	6.4	24.5	27.1	9.6	9.0	0.7	0.7	0.7
3	8.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
5	0.8	1.0	0.9	5.5	5.4	4.6	16.0	15.2
6	2.6	2.9	9.0	5.6	1.8	1.2	0.7	0.7
7	19.6	21.6	3.4	0.7	0.7	0.7	0.7	0.7
8	8.1	8.0	8.9	12.3	13.7	14.8	14.6	13.1
9	4.8	8.7	9.8	11.1	10.1	4.7	9.1	9.1

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	25.8	14.9	17.8	11.0	20.9	15.2	9.5	10.6
2	2.8	2.7	0.8	0.7	0.7	0.7	0.7	0.7
3	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	1.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7
5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
6	11.8	18.0	23.4	15.4	19.8	0.7	0.7	0.7
7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
8	7.8	11.4	10.7	9.4	6.0	7.7	5.9	4.1
9	11.3	10.9	12.9	12.4	11.6	12.7	11.0	8.3

EXPERIMENT 1

MEAN STARTING SCORES OF 1-SEC SUBJECTS GIVEN CONTROLLED HANDLING

PREPUNISHMENT CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	15.4	18.7	17.4	10.9	15.5	16.0	26.6	22.6
2	9.2	4.8	3.2	2.3	0.7	0.7	0.7	0.7
3	6.5	8.0	20.7	12.1	5.7	13.5	24.2	23.6
4	23.7	26.5	28.0	20.8	23.4	31.3	36.7	30.8
5	2.0	5.0	5.5	13.0	2.8	4.6	7.5	16.1
6	1.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7
7	8.7	4.1	8.0	5.4	9.5	7.2	4.6	17.0
8	1.7	6.5	3.6	9.2	8.8	10.5	11.1	10.8
9	6.4	8.1	9.9	9.2	6.8	4.2	4.9	4.3

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	27.4	20.1	11.2	13.4	13.2	12.3	0.7	0.7
2	13.4	11.2	10.8	8.2	3.1	1.2	1.2	1.5
3	6.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	28.1	28.9	26.0	25.7	25.5	11.9	5.0	1.2
5	1.8	1.5	0.7	0.7	0.7	0.7	0.7	0.7
6	10.4	1.1	0.9	0.8	0.7	0.7	0.7	0.7
7	1.2	1.9	3.1	10.0	5.2	1.2	0.7	0.7
8	6.2	7.7	5.8	0.7	0.7	0.7	0.7	0.7
9	11.9	9.5	8.8	10.0	3.1	8.7	11.3	10.2

EXPERIMENT 1

PREPUNISHMENT CRITERION

MEAN STARTING SCORES OF 16-SEC SUBJECTS GIVEN MODIFIED-CONVENTIONAL HANDLING

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	8.1	8.7	6.9	6.4	4.6	9.4	5.2	8.5
2	1.4	0.9	0.7	0.7	0.7	0.7	0.7	0.7
3	5.9	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	29.8	37.3	36.2	16.9	30.5	47.0	18.1	23.5
5	3.6	2.5	4.0	6.4	9.1	10.7	20.5	21.3
6	5.4	4.7	6.4	8.5	0.7	0.7	0.7	0.7
7	8.6	1.1	0.8	0.7	0.7	0.7	0.7	0.7
8	10.5	12.1	12.0	11.1	0.7	0.7	0.7	0.7
9	3.7	1.1	4.6	0.7	0.7	0.7	0.7	0.7

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	15.6	17.0	0.7	0.7	0.7	0.7	0.7	0.7
2	3.3	14.6	1.8	0.7	0.7	0.7	0.7	0.7
3	3.0	8.0	18.0	3.0	6.1	1.0	2.9	1.0
4	1.1	0.7	0.7	0.7	0.7	0.7	0.7	0.7
5	1.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7
6	4.3	0.8	0.7	0.7	0.7	0.7	0.7	0.7
7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
8	3.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7
9	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7

EXPERIMENT 1

MEAN STARTING SCORES OF 16-SEC SUBJECTS GIVEN CONTROLLED HANDLING

PREPUNISHMENT CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	4.0	3.3	7.6	0.7	11.0	5.6	9.3	9.7
2	13.7	5.2	13.3	12.7	4.9	16.1	10.4	14.7
3	14.7	15.1	11.0	2.8	8.9	13.0	0.7	0.7
4	6.5	7.4	8.3	12.5	8.7	7.1	6.1	6.5
5	18.1	19.0	18.3	24.2	22.6	18.6	19.0	11.2
6	10.3	12.5	10.9	7.3	3.5	6.0	8.2	14.5
7	15.3	14.4	1.4	0.7	0.7	0.7	0.7	0.7
8	1.5	8.7	13.8	13.7	11.1	8.1	13.4	14.6
9	9.8	10.6	12.6	11.7	13.2	13.4	9.0	13.5

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	13.2	7.6	20.8	14.7	8.7	0.7	0.7	0.7
2	13.2	19.4	4.1	0.7	0.7	0.7	0.7	0.7
3	5.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	6.3	10.9	15.2	12.8	12.3	12.9	3.1	0.7
5	25.0	8.2	0.7	0.7	0.7	0.7	0.7	0.7
6	29.9	23.4	18.9	19.1	5.7	0.7	0.7	0.7
7	4.7	0.9	0.7	0.7	0.7	0.7	0.7	0.7
8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
9	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7

EXPERIMENT 1 MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 1-SEC SUBJECTS GIVEN MODIFIED CONVENTIONAL HANDLING

PREPUNISHMENT CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	48.0	28.0	18.0	22.0	4.0	4.0	4.0	4.0
2	64.0	76.0	91.0	51.0	5.0	4.0	4.0	4.0
3	115.0	26.0	4.0	4.0	4.0	4.0	4.0	4.0
4	35.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	150.0	146.0	109.0	31.0	17.0	39.0	37.0	17.0
6	146.0	112.0	92.0	51.0	55.0	46.0	4.0	4.0
7	148.0	133.0	20.0	4.0	4.0	4.0	4.0	4.0
8	79.0	35.0	24.0	29.0	22.0	14.0	12.0	17.0
9	89.0	67.0	50.0	61.0	58.0	25.0	17.0	31.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	97.0	90.0	109.0	133.0	110.0	125.0	145.0	142.0
2	98.0	118.0	61.0	4.0	4.0	4.0	4.0	4.0
3	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	109.0	12.0	4.0	4.0	4.0	4.0	4.0	4.0
5	39.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
6	46.0	93.0	101.0	62.0	28.0	4.0	4.0	4.0
7	27.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
8	118.0	132.0	120.0	132.0	141.0	140.0	153.0	128.0
9	100.0	102.0	106.0	115.0	118.0	119.0	109.0	121.0

EXPERIMENT 1 MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 1-SEC SUBJECTS GIVEN CONTROLLED HANDLING

PREPUNISHMENT CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	111.0	104.0	102.0	99.0	83.0	40.0	26.0	38.0
2	37.0	5.0	19.0	21.0	4.0	4.0	4.0	4.0
3	108.0	62.0	88.0	60.0	10.0	12.0	6.0	6.0
4	66.0	64.0	38.0	40.0	32.0	33.0	26.0	35.0
5	92.0	95.0	41.0	65.0	27.0	49.0	52.0	41.0
6	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	141.0	138.0	124.0	45.0	56.0	35.0	17.0	39.0
8	103.0	63.0	24.0	43.0	30.0	21.0	22.0	10.0
9	89.0	93.0	97.0	87.0	71.0	36.0	53.0	38.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	136.0	92.0	127.0	143.0	138.0	109.0	116.0	14.0
2	105.0	86.0	133.0	131.0	131.0	122.0	65.0	105.0
3	107.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	92.0	91.0	84.0	76.0	68.0	79.0	17.0	18.0
5	19.0	15.0	4.0	4.0	4.0	4.0	4.0	4.0
6	153.0	182.0	189.0	172.0	161.0	168.0	4.0	4.0
7	86.0	121.0	88.0	139.0	76.0	159.0	167.0	4.0
8	139.0	143.0	136.0	4.0	4.0	4.0	4.0	4.0
9	104.0	122.0	120.0	91.0	62.0	113.0	123.0	130.0

EXPERIMENT 1 — MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 16-SEC SUBJECTS GIVEN MODIFIED-CONVENTIONAL HANDLING

PREPUNISHMENT CRITERION

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	85.0	40.0	22.0	17.0	8.0	5.0	4.0	4.0
2	14.0	7.0	4.0	4.0	4.0	4.0	4.0	4.0
3	23.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	34.0	24.0	15.0	23.0	20.0	48.0	32.0	39.0
5	115.0	57.0	21.0	13.0	19.0	18.0	23.0	34.0
6	78.0	18.0	52.0	4.0	4.0	4.0	4.0	4.0
7	53.0	28.0	4.0	4.0	4.0	4.0	4.0	4.0
8	70.0	38.0	22.0	23.0	5.0	4.0	4.0	4.0
9	99.0	6.0	4.0	4.0	4.0	4.0	4.0	4.0

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	74.0	44.0	4.0	4.0	4.0	4.0	4.0	4.0
2	57.0	51.0	5.0	4.0	4.0	4.0	4.0	4.0
3	124.0	134.0	143.0	155.0	152.0	135.0	165.0	116.0
4	35.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	30.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
6	60.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	26.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
8	26.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
9	75.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0

EXPERIMENT 1 MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 16-SEC SUBJECTS GIVEN CONTROLLED HANDLING

PREPUNISHMENT CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	57.0	42.0	53.0	4.0	65.0	39.0	72.0	27.0
2	88.0	72.0	48.0	24.0	83.0	31.0	13.0	31.0
3	69.0	14.0	12.0	18.0	23.0	23.0	4.0	4.0
4	81.0	27.0	40.0	27.0	35.0	23.0	49.0	105.0
5	118.0	109.0	57.0	44.0	32.0	51.0	37.0	18.0
6	14.0	58.0	38.0	25.0	23.0	46.0	36.0	30.0
7	10.0	16.0	4.0	4.0	4.0	4.0	4.0	4.0
8	16.0	28.0	21.0	31.0	33.0	16.0	20.0	101.0
9	33.0	47.0	44.0	27.0	27.0	65.0	48.0	54.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	75.0	102.0	94.0	92.0	56.0	4.0	4.0	4.0
2	47.0	47.0	19.0	4.0	4.0	4.0	4.0	4.0
3	30.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	91.0	97.0	122.0	73.0	114.0	128.0	39.0	4.0
5	56.0	38.0	4.0	4.0	4.0	4.0	4.0	4.0
6	87.0	101.0	110.0	68.0	5.0	4.0	4.0	4.0
7	43.0	6.0	4.0	4.0	4.0	4.0	4.0	4.0
8	27.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
9	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0

EXPERIMENT 2

MEAN STARTING SCORES OF
1-SEC DROP-START SUBJECTS

GOALBOX
CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	24.6	7.4	0.7	0.7	0.7	0.7	0.7	0.7
2	15.4	29.7	31.1	27.3	43.0	64.7	54.9	0.7
3	27.6	22.7	33.6	37.5	37.5	34.9	11.9	0.7
4	29.2	20.9	0.7	0.7	0.7	0.7	0.7	0.7
5	19.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7
6	27.9	0.7	0.7	0.7	0.7	0.7	0.7	0.7
7	26.5	50.6	67.0	77.6	56.0	77.4	11.9	0.7
8	15.0	9.6	2.1	0.7	0.7	0.7	0.7	0.7
9	16.1	21.9	33.2	50.2	35.7	37.0	42.4	13.4
10	14.7	18.0	0.9	0.7	0.7	0.7	0.7	0.7

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	11.1	0.7	0.7	0.7	0.7	0.7	0.7	0.7
2	25.7	24.6	26.2	24.3	22.8	25.2	0.7	0.7
3	44.3	48.8	44.3	54.7	67.9	30.0	99.9	99.9
4	3.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7
5	40.2	38.6	41.0	36.6	47.9	75.1	75.1	0.7
6	17.3	22.1	24.9	26.9	28.0	18.5	17.8	0.7
7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
8	14.2	15.5	0.7	0.7	0.7	0.7	0.7	0.7
9	31.9	37.9	29.0	27.3	25.0	25.1	23.7	0.7
10	9.0	13.9	18.1	21.2	21.5	27.7	23.5	23.9

EXPERIMENT 2

MEAN STARTING SCORES OF 1-SEC GUILLOTINE-DOOR SUBJECTS

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	22.9	21.0	22.4	35.9	17.9	11.9	0.7	0.7
2	23.3	17.4	20.8	27.4	5.7	0.7	0.7	0.7
3	4.8	26.6	34.2	54.8	36.0	38.9	0.7	0.7
4	29.0	44.9	30.8	39.6	43.1	7.8	0.7	0.7
5	10.6	14.9	14.9	16.1	7.4	0.7	0.7	0.7
6	22.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7
7	38.1	33.5	33.3	36.2	37.8	44.8	0.7	0.7
8	24.5	15.6	22.8	27.7	27.5	22.4	0.7	0.7
9	34.5	35.8	38.8	0.7	0.7	0.7	0.7	0.7
10	16.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	67.7	57.3	50.5	32.2	63.0	59.5	37.6	38.7
2	8.6	10.1	13.5	5.9	4.9	19.0	0.7	0.7
3	15.8	11.5	0.7	0.7	0.7	0.7	0.7	0.7
4	11.4	20.9	25.9	20.2	24.8	29.3	14.5	0.7
5	25.7	44.6	40.2	37.8	49.9	32.6	46.6	50.1
6	23.1	8.9	4.5	0.7	0.7	0.7	0.7	0.7
7	23.9	12.2	18.0	16.9	15.8	14.5	0.9	0.7
8	18.1	8.0	2.1	6.9	8.1	0.7	0.7	0.7
9	28.9	26.1	43.2	51.4	45.9	52.2	39.6	4.1
10	16.4	19.1	15.6	20.0	0.7	0.7	0.7	0.7

EXPERIMENT 2

MEAN STARTING SCORES OF
16-SEC DROP-START SUBJECTS

GOALBOX
CRITERION

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	45.0	32.1	0.7	0.7	0.7	0.7	0.7	0.7
2	2.9	10.2	7.3	7.9	30.2	58.1	38.8	39.8
3	21.1	29.4	18.5	31.8	36.2	30.0	0.7	0.7
4	17.6	35.4	48.3	57.8	60.8	0.7	0.7	0.7
5	15.6	23.9	25.5	27.8	27.3	33.7	14.4	0.7
6	26.4	37.3	37.9	45.0	34.1	0.7	0.7	0.7
7	29.9	11.6	11.0	0.7	0.7	0.7	0.7	0.7
8	26.3	34.7	35.4	35.7	39.5	19.5	0.7	0.7
9	34.8	36.6	37.8	48.9	25.4	0.7	0.7	0.7
10	31.4	24.5	20.0	38.7	0.7	0.7	0.7	0.7

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	25.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7
2	30.2	34.6	49.6	55.6	23.7	28.3	26.1	0.7
3	30.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	32.0	35.8	33.6	37.1	39.3	32.7	46.6	39.0
5	11.9	32.9	32.4	42.8	51.7	75.1	0.7	0.7
6	4.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7
7	26.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7
8	20.3	37.4	52.7	70.0	75.1	49.8	37.7	57.6
9	34.4	28.6	33.4	37.8	10.2	0.7	0.7	0.7
10	26.2	38.9	44.3	41.1	29.4	17.4	44.4	37.9

EXPERIMENT 2

MEAN STARTING SCORES OF 16-SEC GUILLOTINE-DOOR SUBJECTS

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	42.2	21.2	0.7	0.7	0.7	0.7	0.7	0.7
2	33.0	0.7	0.7	0.7	0.7	0.7	0.7	0.7
3	12.5	15.4	19.4	10.7	0.7	0.7	0.7	0.7
4	32.9	16.0	0.7	0.7	0.7	0.7	0.7	0.7
5	19.3	20.9	10.4	25.8	3.5	0.7	0.7	0.7
6	37.3	24.5	19.6	0.7	0.7	0.7	0.7	0.7
7	61.9	30.0	0.7	0.7	0.7	0.7	0.7	0.7
8	27.9	22.8	2.2	0.7	0.7	0.7	0.7	0.7
9	23.2	4.2	0.7	0.7	0.7	0.7	0.7	0.7
10	18.9	30.2	36.0	36.7	43.5	31.4	0.7	0.7

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	17.4	2.5	0.7	0.7	0.7	0.7	0.7	0.7
2	41.0	30.9	29.9	34.3	32.8	40.2	42.8	18.2
3	30.1	25.0	28.6	21.7	27.9	30.4	23.4	0.7
4	24.2	7.5	0.7	0.7	0.7	0.7	0.7	0.7
5	55.6	59.0	47.2	57.0	48.5	60.7	37.0	0.7
6	29.3	16.3	0.7	0.7	0.7	0.7	0.7	0.7
7	17.7	21.0	29.2	0.7	0.7	0.7	0.7	0.7
8	11.2	2.7	12.0	17.8	16.5	6.0	0.7	0.7
9	14.1	10.2	0.7	0.7	0.7	0.7	0.7	0.7
10	40.0	34.2	35.5	35.2	0.7	0.7	0.7	0.7

EXPERIMENT 2

MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 1-SEC DROP-START SUBJECTS

NONPUNISHED SUBJECT	EXTINCTION DAYS 1	2	3	4	5	6	7	8
1	75.0	20.0	4.0	4.0	4.0	4.0	4.0	4.0
2	65.0	55.0	66.0	71.0	77.0	70.0	46.0	19.0
3	107.0	73.0	78.0	78.0	83.0	46.0	17.0	4.0
4	24.0	12.0	4.0	4.0	4.0	4.0	4.0	4.0
5	21.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
6	70.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	82.0	82.0	97.0	94.0	75.0	52.0	4.0	4.0
8	83.0	67.0	18.0	4.0	4.0	4.0	4.0	4.0
9	69.0	69.0	58.0	43.0	50.0	34.0	33.0	31.0
10	73.0	24.0	6.0	4.0	4.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAYS 1	2	3	4	5	6	7	8
1	142.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2	64.0	53.0	63.0	58.0	58.0	18.0	4.0	4.0
3	118.0	113.0	127.0	116.0	124.0	122.0	124.0	117.0
4	52.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	70.0	73.0	72.0	98.0	91.0	57.0	58.0	5.0
6	99.0	107.0	109.0	97.0	105.0	74.0	58.0	4.0
7	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
8	50.0	52.0	5.0	4.0	4.0	4.0	4.0	4.0
9	59.0	59.0	53.0	32.0	19.0	38.0	4.0	4.0
10	96.0	116.0	103.0	112.0	109.0	110.0	81.0	117.0

EXPERIMENT 2

MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 1-SEC GUILLOTINE-DOOR SUBJECTS

GOALBOX CRITERION

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	89.0	60.0	60.0	52.0	35.0	12.0	4.0	4.0
2	87.0	77.0	84.0	83.0	28.0	4.0	4.0	4.0
3	68.0	80.0	75.0	67.0	41.0	18.0	4.0	4.0
4	58.0	54.0	58.0	63.0	37.0	4.0	4.0	4.0
5	115.0	107.0	79.0	77.0	34.0	4.0	4.0	4.0
6	99.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	99.0	99.0	117.0	92.0	114.0	103.0	24.0	4.0
8	77.0	61.0	62.0	64.0	27.0	13.0	4.0	4.0
9	94.0	113.0	129.0	26.0	4.0	4.0	4.0	4.0
10	94.0	22.0	4.0	4.0	4.0	4.0	4.0	4.0

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	43.0	34.0	32.0	24.0	18.0	10.0	8.0	12.0
2	70.0	29.0	15.0	14.0	22.0	17.0	4.0	4.0
3	91.0	100.0	4.0	4.0	4.0	4.0	4.0	4.0
4	93.0	72.0	86.0	68.0	72.0	47.0	17.0	4.0
5	109.0	122.0	133.0	125.0	135.0	133.0	108.0	136.0
6	106.0	115.0	115.0	4.0	4.0	4.0	4.0	4.0
7	90.0	55.0	72.0	55.0	80.0	43.0	5.0	4.0
8	41.0	8.0	28.0	26.0	6.0	4.0	4.0	4.0
9	118.0	109.0	89.0	76.0	33.0	12.0	18.0	44.0
10	132.0	135.0	129.0	136.0	4.0	4.0	4.0	4.0

EXPERIMENT 2

MEAN FIRST SEGMENT (PREPUNISHMENT)
BBEEDS OF 16-SEC DROP-START SUBJECTS

GOALBOX
CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	51.0	15.0	4.0	4.0	4.0	4.0	4.0	4.0
2	49.0	61.0	68.0	72.0	68.0	77.0	48.0	36.0
3	56.0	70.0	15.0	63.0	72.0	36.0	4.0	4.0
4	62.0	59.0	41.0	39.0	33.0	4.0	4.0	4.0
5	62.0	71.0	67.0	58.0	64.0	54.0	19.0	4.0
6	106.0	106.0	122.0	101.0	69.0	4.0	4.0	4.0
7	39.0	21.0	20.0	4.0	4.0	4.0	4.0	4.0
8	60.0	50.0	51.0	46.0	43.0	35.0	4.0	4.0
9	52.0	30.0	8.0	27.0	45.0	4.0	4.0	4.0
10	127.0	87.0	48.0	62.0	4.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	67.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2	88.0	79.0	106.0	97.0	81.0	79.0	72.0	4.0
3	87.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	109.0	111.0	106.0	114.0	110.0	14.0	37.0	5.0
5	33.0	35.0	38.0	37.0	44.0	46.0	4.0	4.0
6	11.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	12.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
8	101.0	104.0	117.0	103.0	118.0	67.0	94.0	107.0
9	72.0	36.0	63.0	81.0	21.0	4.0	4.0	4.0
10	108.0	112.0	113.0	119.0	110.0	76.0	107.0	115.0

EXPERIMENT 2

MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 16-SEC GUILLOTINE-DOOR SUBJECTS

GOALBOX CRITERION
CRITERION

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	90.0	17.0	4.0	4.0	4.0	4.0	4.0	4.0
2	66.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3	60.0	53.0	43.0	26.0	4.0	4.0	4.0	4.0
4	72.0	32.0	4.0	4.0	4.0	4.0	4.0	4.0
5	97.0	39.0	6.0	19.0	56.0	4.0	4.0	4.0
6	111.0	76.0	26.0	4.0	4.0	4.0	4.0	4.0
7	95.0	91.0	4.0	4.0	4.0	4.0	4.0	4.0
8	119.0	61.0	4.0	4.0	4.0	4.0	4.0	4.0
9	107.0	29.0	4.0	4.0	4.0	4.0	4.0	4.0
10	102.0	105.0	102.0	91.0	60.0	53.0	4.0	4.0

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	107.0	6.0	4.0	4.0	4.0	4.0	4.0	4.0
2	27.0	50.0	72.0	54.0	33.0	48.0	56.0	9.0
3	65.0	75.0	86.0	47.0	46.0	43.0	22.0	4.0
4	117.0	7.0	4.0	4.0	4.0	4.0	4.0	4.0
5	111.0	108.0	97.0	103.0	105.0	95.0	55.0	4.0
6	101.0	70.0	4.0	4.0	4.0	4.0	4.0	4.0
7	36.0	59.0	61.0	4.0	4.0	4.0	4.0	4.0
8	47.0	18.0	23.0	30.0	12.0	16.0	4.0	4.0
9	79.0	49.0	4.0	4.0	4.0	4.0	4.0	4.0
10	103.0	82.0	75.0	69.0	8.0	4.0	4.0	4.0

EXPERIMENT 2

MEAN THIRD SEGMENT (POSTPUNISHMENT) SPEEDS OF 1-SEC DROP-START SUBJECTS

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	60.0	19.0	4.0	4.0	4.0	4.0	4.0	4.0
2	83.0	56.0	52.0	61.0	45.0	56.0	57.0	4.0
3	96.0	51.0	46.0	64.0	61.0	48.0	15.0	4.0
4	51.0	42.0	4.0	4.0	4.0	4.0	4.0	4.0
5	20.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
6	28.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	86.0	106.0	89.0	89.0	78.0	51.0	19.0	4.0
8	99.0	46.0	15.0	4.0	4.0	4.0	4.0	4.0
9	73.0	87.0	72.0	64.0	60.0	53.0	53.0	60.0
10	73.0	42.0	21.0	4.0	4.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	102.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2	85.0	82.0	91.0	78.0	58.0	58.0	4.0	4.0
3	136.0	142.0	149.0	146.0	140.0	139.0	143.0	143.0
4	73.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	59.0	55.0	51.0	60.0	41.0	37.0	30.0	4.0
6	78.0	99.0	103.0	115.0	95.0	75.0	47.0	4.0
7	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
8	63.0	81.0	26.0	4.0	4.0	4.0	4.0	4.0
9	85.0	93.0	94.0	57.0	67.0	59.0	48.0	4.0
10	123.0	125.0	127.0	126.0	119.0	120.0	113.0	129.0

EXPERIMENT 2

MEAN THIRD SEGMENT (POSTPUNISHMENT) SPEEDS OF 1-SEC GUILLOTINE-DOOR SUBJECTS

GOALBOX CRITERION

	EXTINCTION DAY							
NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	42.0	39.0	49.0	29.0	33.0	15.0	4.0	4.0
2	77.0	38.0	31.0	48.0	22.0	4.0	4.0	4.0
3	77.0	91.0	77.0	77.0	61.0	43.0	4.0	4.0
4	72.0	77.0	78.0	79.0	41.0	10.0	4.0	4.0
5	120.0	49.0	30.0	22.0	39.0	4.0	4.0	4.0
6	99.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	77.0	31.0	53.0	55.0	35.0	64.0	19.0	4.0
8	58.0	58.0	58.0	65.0	52.0	76.0	4.0	4.0
9	129.0	126.0	123.0	26.0	4.0	4.0	4.0	4.0
10	25.0	16.0	4.0	4.0	4.0	4.0	4.0	4.0

	EXTINCTION DAY							
PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	53.0	29.0	26.0	47.0	38.0	20.0	34.0	55.0
2	64.0	86.0	66.0	50.0	61.0	69.0	4.0	4.0
3	110.0	120.0	4.0	4.0	4.0	4.0	4.0	4.0
4	83.0	69.0	89.0	73.0	73.0	21.0	17.0	4.0
5	109.0	117.0	118.0	113.0	116.0	122.0	128.0	116.0
6	120.0	151.0	138.0	4.0	4.0	4.0	4.0	4.0
7	108.0	131.0	126.0	99.0	114.0	61.0	22.0	4.0
8	68.0	75.0	111.0	94.0	56.0	4.0	4.0	4.0
9	117.0	117.0	77.0	77.0	81.0	73.0	79.0	86.0
10	141.0	151.0	142.0	144.0	4.0	4.0	4.0	4.0

EXPERIMENT 2

MEAN THIRD SEGMENT (POSTPUNISHMENT) SPEEDS OF 16-SEC DROP-START SUBJECTS

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	35.0	46.0	4.0	4.0	4.0	4.0	4.0	4.0
2	62.0	72.0	78.0	84.0	80.0	88.0	69.0	67.0
3	67.0	102.0	15.0	91.0	119.0	80.0	4.0	4.0
4	54.0	41.0	25.0	13.0	27.0	4.0	4.0	4.0
5	64.0	69.0	65.0	59.0	67.0	76.0	55.0	4.0
6	81.0	32.0	90.0	60.0	46.0	4.0	4.0	4.0
7	61.0	120.0	19.0	4.0	4.0	4.0	4.0	4.0
8	70.0	51.0	49.0	69.0	78.0	90.0	4.0	4.0
9	37.0	73.0	35.0	32.0	39.0	4.0	4.0	4.0
10	101.0	41.0	25.0	51.0	4.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	74.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2	91.0	94.0	100.0	90.0	68.0	68.0	77.0	4.0
3	70.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	111.0	122.0	127.0	121.0	117.0	122.0	92.0	100.0
5	61.0	81.0	67.0	66.0	69.0	69.0	4.0	4.0
6	104.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	34.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
8	87.0	118.0	108.0	93.0	116.0	69.0	83.0	107.0
9	53.0	59.0	56.0	53.0	10.0	4.0	4.0	4.0
10	125.0	127.0	129.0	118.0	107.0	95.0	121.0	125.0

EXPERIMENT 2

GOALBOX CRITERION

MEAN THIRD SEGMENT (POSTPUNISHMENT) SPEEDS OF 16-SEC GUILLOTINE-DOOR SUBJECTS

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	104.0	11.0	4.0	4.0	4.0	4.0	4.0	4.0
2	51.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3	51.0	47.0	55.0	35.0	4.0	4.0	4.0	4.0
4	47.0	73.0	4.0	4.0	4.0	4.0	4.0	4.0
5	51.0	39.0	28.0	57.0	55.0	4.0	4.0	4.0
6	82.0	50.0	21.0	4.0	4.0	4.0	4.0	4.0
7	88.0	94.0	4.0	4.0	4.0	4.0	4.0	4.0
8	89.0	34.0	9.0	4.0	4.0	4.0	4.0	4.0
9	37.0	9.0	4.0	4.0	4.0	4.0	4.0	4.0
10	81.0	67.0	65.0	72.0	53.0	56.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	29.0	11.0	4.0	4.0	4.0	4.0	4.0	4.0
2	66.0	86.0	84.0	67.0	26.0	65.0	56.0	53.0
3	131.0	119.0	166.0	123.0	133.0	130.0	124.0	4.0
4	110.0	14.0	4.0	4.0	4.0	4.0	4.0	4.0
5	95.0	101.0	29.0	45.0	69.0	61.0	77.0	4.0
6	94.0	91.0	4.0	4.0	4.0	4.0	4.0	4.0
7	63.0	137.0	128.0	4.0	4.0	4.0	4.0	4.0
8	35.0	20.0	21.0	58.0	76.0	58.0	4.0	4.0
9	104.0	36.0	4.0	4.0	4.0	4.0	4.0	4.0
10	121.0	93.0	102.0	86.0	18.0	4.0	4.0	4.0

EXPERIMENT 2

MEAN STARTING SCORES OF
1-SEC DROP-START SUBJECTS

PREPUNISHMENT
CRITERION

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	24.6	20.8	7.4	21.6	33.6	48.0	30.9	40.1
2	15.4	29.4	31.1	27.3	43.0	64.7	54.9	51.3
3	27.6	22.7	33.6	37.5	37.5	34.9	41.1	61.5
4	29.2	21.1	30.2	23.6	19.1	29.6	17.0	17.9
5	19.5	28.3	4.8	30.8	17.3	0.7	0.7	0.7
6	27.9	15.1	5.5	0.7	0.7	0.7	0.7	0.7
7	26.5	50.6	67.0	77.6	56.0	77.4	55.0	45.6
8	15.0	9.6	12.7	0.7	0.7	0.7	0.7	0.7
9	16.1	21.9	33.2	50.2	35.7	37.0	42.4	13.4
10	14.7	18.0	8.2	0.7	0.7	0.7	0.7	0.7

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	11.1	4.1	0.7	0.7	0.7	0.7	0.7	0.7
2	25.7	24.6	26.2	24.3	22.8	25.2	6.2	0.7
3	44.2	48.8	44.3	54.7	67.9	30.0	99.9	99.9
4	3.4	1.2	0.7	0.7	0.7	0.7	0.7	0.7
5	40.2	38.6	41.0	36.6	47.9	75.1	75.1	6.5
6	17.3	22.1	24.5	26.9	28.0	18.5	17.8	7.9
7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
8	14.2	15.5	0.7	0.7	0.7	0.7	0.7	0.7
9	31.9	37.9	29.0	27.3	25.0	25.1	23.7	0.7
10	9.0	13.9	18.1	21.2	21.5	27.7	23.5	23.9

EXPERIMENT 2

MEAN STARTING SCORES OF 1-SEC GUILLOTINE-DOOR SUBJECTS

PREPUNISHMENT CRITERION

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	29.9	21.0	22.4	35.9	17.9	61.0	54.9	22.5
2	23.3	17.4	20.8	27.4	7.7	17.2	19.6	20.2
3	4.8	26.6	34.2	54.8	36.0	38.9	50.3	58.1
4	29.0	44.9	30.8	39.6	43.1	36.9	28.6	15.9
5	10.6	14.9	14.9	16.1	15.8	15.2	4.6	14.1
6	22.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7
7	38.1	33.5	33.3	36.2	37.8	44.8	25.3	37.2
8	24.5	15.6	22.8	27.7	27.5	40.1	16.1	14.2
9	34.5	35.8	38.8	14.7	14.5	8.1	3.3	24.0
10	16.4	8.4	7.4	0.7	0.7	0.7	0.7	0.7

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	67.7	57.3	50.5	32.2	63.0	59.5	37.6	38.7
2	8.6	10.1	13.5	5.9	4.9	19.0	3.7	7.5
3	15.8	11.5	0.8	0.7	0.7	0.7	0.7	0.7
4	11.4	26.0	25.9	20.2	24.8	29.3	50.5	44.9
5	25.7	44.6	40.2	37.8	49.9	32.6	46.6	50.1
6	23.1	8.7	4.5	0.7	0.7	0.7	0.7	0.7
7	23.9	12.2	18.0	16.9	15.8	14.5	11.2	0.7
8	18.1	8.0	2.1	6.9	8.2	0.7	0.7	0.7
9	28.9	26.1	43.2	51.4	45.9	52.2	39.6	4.1
10	16.4	19.1	15.6	20.0	1.4	0.7	0.7	0.7

EXPERIMENT 2

MEAN STARTING SCORES OF
16-SEC DROP-START SUBJECTS

PREPUNISHMENT
CRITERION

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	45.0	32.1	3.8	33.1	29.0	2.1	2.6	77.3
2	2.9	10.2	7.3	7.9	30.2	58.1	38.8	39.8
3	21.1	29.4	18.5	31.8	36.2	30.0	38.2	8.8
4	17.6	35.4	48.3	57.8	60.8	75.1	68.2	69.9
5	15.6	23.9	25.5	27.8	27.3	33.7	58.1	46.2
6	26.4	37.3	37.9	45.0	34.1	57.6	56.9	61.4
7	29.9	11.6	34.5	34.6	29.9	53.4	24.8	29.1
8	26.3	34.7	35.4	35.7	39.5	19.5	16.0	0.7
9	34.8	36.6	37.8	48.9	25.4	61.7	63.8	41.1
10	31.4	24.5	20.0	38.7	16.3	0.7	0.7	0.7

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	25.4	1.1	0.7	0.7	0.7	0.7	0.7	0.7
2	30.2	34.6	49.6	55.6	23.7	28.3	26.1	8.4
3	30.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	32.0	35.8	33.6	37.1	39.3	32.7	46.6	39.0
5	11.9	32.9	32.4	42.8	51.7	75.1	0.7	0.7
6	4.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7
7	31.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7
8	20.3	37.4	52.7	70.0	75.1	49.8	37.7	57.6
9	34.4	28.6	33.4	37.8	40.5	0.7	0.7	0.7
10	26.2	38.9	44.3	41.1	29.4	17.4	44.4	37.9

EXPERIMENT 2

MEAN STARTING SCORES OF 16-SEC GUILLOTINE-DOOR SUBJECTS

PREPUNISHMENT CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	42.2	22.1	5.9	54.5	59.1	47.2	0.7	0.7
2	33.0	22.6	19.6	19.2	17.9	9.5	0.7	8.4
3	12.5	15.4	19.4	21.9	26.3	31.2	0.7	0.7
4	32.9	16.0	20.0	23.6	19.4	15.7	14.1	0.7
5	19.3	20.9	10.4	25.8	3.5	15.3	18.7	0.7
6	37.3	24.5	30.5	40.2	40.1	58.0	55.6	13.0
7	61.9	30.0	11.6	29.8	11.5	9.0	7.4	8.8
8	27.9	22.8	3.1	24.2	23.8	19.7	2.2	0.7
9	23.2	24.3	33.9	19.1	0.7	0.7	0.7	0.7
10	18.9	30.2	36.0	36.7	43.5	31.8	54.2	42.9

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	17.4	6.4	0.7	0.7	0.7	0.7	0.7	0.7
2	41.0	30.9	29.9	35.3	32.8	40.2	42.8	18.2
3	30.1	25.0	28.6	21.7	27.9	30.4	23.1	0.7
4	24.2	7.6	0.7	0.7	0.7	0.7	0.7	0.7
5	55.6	59.0	47.2	57.0	48.5	60.7	37.8	42.7
6	29.3	16.3	2.1	0.7	0.7	0.7	0.7	0.7
7	17.7	21.0	29.2	0.7	0.7	0.7	0.7	0.7
8	11.2	2.7	12.0	17.8	16.5	6.0	0.7	0.7
9	14.1	27.2	0.7	0.7	0.7	0.7	0.7	0.7
10	40.0	34.2	35.5	35.2	1.4	0.7	0.7	0.7

EXPERIMENT 2

PREPUNISHMENT CRITERION

MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 1-SEC DROP-START SUBJECTS

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	75.0	27.0	8.0	8.0	24.0	22.0	28.0	12.0
2	65.0	55.0	66.0	71.0	77.0	70.0	46.0	19.0
3	107.0	73.0	78.0	78.0	83.0	46.0	31.0	45.0
4	24.0	18.0	14.0	9.0	10.0	10.0	13.0	11.0
5	21.0	25.0	4.0	10.0	4.0	4.0	4.0	4.0
6	70.0	25.0	6.0	4.0	4.0	4.0	4.0	4.0
7	82.0	82.0	97.0	94.0	75.0	52.0	43.0	30.0
8	83.0	67.0	42.0	46.0	30.0	51.0	27.0	34.0
9	69.0	69.0	58.0	43.0	50.0	34.0	33.0	31.0
10	76.0	24.0	6.0	4.0	4.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	142.0	28.0	4.0	4.0	4.0	4.0	4.0	4.0
2	64.0	53.0	63.0	58.0	58.0	18.0	4.0	4.0
3	118.0	113.0	127.0	116.0	124.0	122.0	124.0	117.0
4	52.0	11.0	4.0	4.0	4.0	4.0	4.0	4.0
5	70.0	73.0	72.0	98.0	91.0	57.0	58.0	5.0
6	99.0	107.0	109.0	97.0	105.0	74.0	58.0	14.0
7	13.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
8	50.0	52.0	5.0	4.0	4.0	4.0	4.0	4.0
9	59.0	59.0	53.0	32.0	19.0	38.0	5.0	4.0
10	96.0	116.0	103.0	112.0	109.0	110.0	81.0	117.0

EXPERIMENT 2

MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 1-SEC GUILLOTINE-DOOR SUBJECTS

PREPUNISHMENT CRITERION

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	89.0	60.0	60.0	52.0	35.0	26.0	39.0	9.0
2	87.0	77.0	84.0	83.0	30.0	7.0	70.0	25.0
3	68.0	80.0	75.0	67.0	41.0	27.0	14.0	19.0
4	58.0	54.0	58.0	63.0	37.0	20.0	9.0	13.0
5	115.0	107.0	79.0	77.0	81.0	76.0	29.0	20.0
6	59.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	99.0	99.0	117.0	92.0	114.0	103.0	73.0	52.0
8	77.0	61.0	62.0	64.0	27.0	28.0	27.0	24.0
9	94.0	113.0	129.0	58.0	8.0	11.0	31.0	46.0
10	94.0	39.0	5.0	4.0	4.0	4.0	4.0	4.0

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	43.0	34.0	32.0	24.0	18.0	10.0	8.0	12.0
2	70.0	29.0	15.0	14.0	22.0	17.0	8.0	12.0
3	91.0	100.0	4.0	4.0	4.0	4.0	4.0	4.0
4	93.0	72.0	86.0	68.0	72.0	47.0	51.0	52.0
5	109.0	122.0	133.0	125.0	135.0	133.0	108.0	136.0
6	106.0	115.0	115.0	4.0	4.0	4.0	4.0	4.0
7	90.0	55.0	72.0	55.0	80.0	43.0	5.0	4.0
8	41.0	8.0	28.0	26.0	6.0	4.0	4.0	4.0
9	118.0	109.0	89.0	76.0	33.0	12.0	18.0	4.0
10	132.0	135.0	129.0	136.0	33.0	4.0	4.0	4.0

EXPERIMENT 2

MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 16-SEC DROP-START SUBJECTS

PREPUNISHMENT CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	51.0	15.0	18.0	15.0	42.0	4.0	28.0	6.0
2	49.0	61.0	68.0	72.0	68.0	77.0	48.0	36.0
3	56.0	70.0	15.0	63.0	72.0	36.0	29.0	10.0
4	62.0	59.0	41.0	39.0	33.0	16.0	14.0	10.0
5	62.0	71.0	67.0	58.0	64.0	54.0	87.0	25.0
6	106.0	106.0	122.0	101.0	70.0	57.0	32.0	63.0
7	39.0	21.0	41.0	21.0	7.0	17.0	11.0	16.0
8	60.0	50.0	51.0	46.0	43.0	37.0	21.0	4.0
9	52.0	30.0	8.0	27.0	50.0	57.0	32.0	28.0
10	127.0	87.0	48.0	71.0	23.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	67.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0
2	88.0	79.0	106.0	97.0	81.0	79.0	72.0	4.0
3	87.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4	109.0	111.0	106.0	114.0	110.0	14.0	37.0	5.0
5	33.0	35.0	38.0	37.0	44.0	46.0	4.0	4.0
6	11.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	47.0	50.0	52.0	4.0	4.0	4.0	4.0	4.0
8	101.0	104.0	117.0	103.0	118.0	67.0	94.0	107.0
9	72.0	36.0	63.0	81.0	52.0	4.0	4.0	4.0
10	108.0	112.0	113.0	119.0	110.0	76.0	107.0	115.0

EXPERIMENT 2

MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF 16-SEC GUILLOTINE-DOOR SUBJECTS

PREPUNISHMENT CRITERION

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	90.0	17.0	21.0	18.0	12.0	10.0	4.0	4.0
2	66.0	19.0	22.0	10.0	13.0	13.0	15.0	20.0
3	60.0	53.0	43.0	26.0	65.0	64.0	4.0	4.0
4	72.0	32.0	33.0	28.0	30.0	17.0	19.0	45.0
5	97.0	39.0	6.0	19.0	56.0	25.0	17.0	4.0
6	111.0	76.0	45.0	73.0	65.0	15.0	11.0	4.0
7	95.0	91.0	12.0	13.0	4.0	4.0	4.0	4.0
8	119.0	61.0	14.0	34.0	21.0	42.0	13.0	4.0
9	107.0	61.0	10.0	6.0	4.0	4.0	4.0	4.0
10	102.0	105.0	102.0	91.0	60.0	56.0	9.0	29.0

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	107.0	15.0	4.0	4.0	4.0	4.0	4.0	4.0
2	27.0	50.0	72.0	54.0	33.0	48.0	56.0	9.0
3	65.0	75.0	86.0	47.0	46.0	43.0	22.0	4.0
4	117.0	7.0	4.0	4.0	4.0	4.0	4.0	4.0
5	111.0	108.0	97.0	103.0	105.0	95.0	55.0	89.0
6	101.0	70.0	4.0	4.0	4.0	4.0	4.0	4.0
7	36.0	59.0	61.0	4.0	4.0	4.0	4.0	4.0
8	47.0	18.0	23.0	30.0	12.0	16.0	4.0	4.0
9	79.0	97.0	4.0	4.0	4.0	4.0	4.0	4.0
10	103.0	82.0	75.0	69.0	18.0	4.0	4.0	4.0

EXPERIMENT 3

MEAN STARTING SCORES OF
GUILLOTINE-DOOR SUBJECTS

GOALBOX
CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	59.9	50.8	38.5	60.5	107.0	94.4	108.0	102.0
2	56.7	75.1	21.0	27.7	26.4	0.7	0.7	0.7
3	68.5	66.7	86.5	85.7	60.5	63.0	0.7	0.7
4	18.3	0.7	0.7	0.7	0.7	0.7	0.7	0.7
5	59.7	66.5	75.1	67.2	0.7	0.7	0.7	0.7
6	0.9	0.7	0.7	0.7	0.7	0.7	0.7	0.7
7	42.0	48.6	55.3	16.2	0.7	0.7	0.7	0.7
8	38.2	27.6	39.2	33.5	77.4	94.4	36.1	0.7
9	80.6	79.3	36.7	0.7	0.7	0.7	0.7	0.7
10	26.9	59.7	53.3	35.3	0.7	0.7	0.7	0.7
11	65.0	50.7	82.3	50.5	0.7	0.7	0.7	0.7

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	53.2	41.8	52.7	64.7	53.4	44.2	47.2	35.2
2	26.0	30.8	34.1	24.5	22.2	0.7	0.7	0.7
3	46.5	52.8	41.9	47.7	57.8	47.5	46.7	43.7
4	11.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7
5	70.8	77.4	82.3	87.5	64.5	94.4	72.8	55.1
6	14.4	13.5	19.0	22.4	19.0	9.5	18.2	14.2
7	67.9	90.9	87.7	0.7	0.7	0.7	0.7	0.7
8	1.8	1.1	0.7	0.7	0.7	0.7	0.7	0.7
9	27.7	60.1	53.9	45.5	54.5	28.6	22.6	0.7
10	81.3	50.4	40.7	44.8	63.0	55.6	54.3	47.3
11	33.0	6.7	1.4	1.0	8.6	0.7	0.7	0.7

EXPERIMENT 3

MEAN STARTING SCORES OF
DROP-START SUBJECTS

GOALBOX
CRITERION

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	76.2	97.9	93.2	65.7	101.0	84.9	90.6	102.0
2	67.7	82.3	72.4	61.7	50.5	0.7	0.7	0.7
3	74.0	91.7	94.4	36.8	0.7	0.7	0.7	0.7
4	45.5	68.5	90.8	63.4	108.0	42.0	0.7	0.7
5	44.3	99.1	77.4	57.4	0.7	0.7	0.7	0.7
6	90.6	95.1	122.0	119.0	62.8	0.7	0.7	0.7
7	29.0	32.1	31.5	22.3	35.3	29.9	6.2	0.7
8	105.0	42.0	57.5	68.7	82.3	84.9	0.7	0.7
9	68.5	90.5	115.0	99.1	102.0	95.8	43.2	0.7
10	45.5	57.9	81.5	50.5	0.7	0.7	0.7	0.7
11	43.3	47.3	66.0	75.1	39.9	33.8	0.7	0.7

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	68.2	89.6	122.0	140.0	84.9	87.8	112.0	87.2
2	55.9	57.6	68.4	62.7	53.8	29.4	64.7	36.5
3	69.8	54.6	32.8	52.1	75.3	61.3	67.0	44.9
4	68.9	57.8	50.2	0.7	0.7	0.7	0.7	0.7
5	95.8	91.7	89.2	105.0	94.9	93.5	83.3	91.7
6	57.4	86.5	58.5	0.7	0.7	0.7	0.7	0.7
7	67.9	90.9	87.7	119.0	113.0	94.4	0.7	0.7
8	95.8	83.3	0.7	0.7	0.7	0.7	0.7	0.7
9	35.6	37.6	29.6	81.5	61.6	77.8	84.5	80.4
10	97.9	50.4	109.0	44.8	97.9	86.1	100.0	108.0
11	53.1	117.0	119.0	113.0	113.0	117.0	97.9	97.9

EXPERIMENT 3

GOALBOX CRITERION

MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF GUILLOTINE-DOOR SUBJECTS

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	82.0	103.0	83.0	84.0	86.0	87.0	82.0	71.0
2	104.0	118.0	103.0	82.0	57.0	4.0	4.0	4.0
3	74.0	69.0	69.0	66.0	71.0	49.0	4.0	4.0
4	38.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	87.0	54.0	84.0	53.0	4.0	4.0	4.0	4.0
6	38.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	65.0	55.0	50.0	15.0	4.0	4.0	4.0	4.0
8	105.0	99.0	85.0	78.0	63.0	85.0	24.0	4.0
9	66.0	81.0	81.0	4.0	4.0	4.0	4.0	4.0
10	92.0	68.0	38.0	14.0	4.0	4.0	4.0	4.0
11	39.0	29.0	72.0	20.0	4.0	4.0	4.0	4.0

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	100.0	120.0	119.0	123.0	128.0	127.0	138.0	124.0
2	85.0	102.0	115.0	105.0	58.0	4.0	4.0	4.0
3	51.0	66.0	80.0	73.0	99.0	43.0	4.0	4.0
4	64.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	82.0	84.0	93.0	89.0	84.0	85.0	86.0	83.0
6	119.0	134.0	158.0	161.0	153.0	170.0	153.0	127.0
7	88.0	102.0	77.0	4.0	4.0	4.0	4.0	4.0
8	88.0	65.0	4.0	4.0	4.0	4.0	4.0	4.0
9	46.0	66.0	16.0	55.0	76.0	91.0	85.0	4.0
10	86.0	69.0	86.0	78.0	90.0	94.0	103.0	81.0
11	67.0	25.0	81.0	58.0	47.0	58.0	90.0	49.0

EXPERIMENT 3

MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF DROP-START SUBJECTS

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	111.0	125.0	137.0	107.0	123.0	137.0	92.0	109.0
2	91.0	108.0	112.0	81.0	29.0	4.0	4.0	4.0
3	91.0	93.0	43.0	33.0	4.0	4.0	4.0	4.0
4	88.0	90.0	96.0	99.0	82.0	23.0	4.0	4.0
5	96.0	101.0	99.0	68.0	4.0	4.0	4.0	4.0
6	102.0	100.0	100.0	85.0	33.0	4.0	4.0	4.0
7	95.0	103.0	103.0	86.0	105.0	51.0	26.0	4.0
8	67.0	78.0	89.0	91.0	94.0	31.0	4.0	4.0
9	93.0	112.0	114.0	99.0	112.0	122.0	50.0	4.0
10	46.0	50.0	50.0	31.0	4.0	4.0	4.0	4.0
11	90.0	88.0	91.0	66.0	78.0	38.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	115.0	126.0	131.0	126.0	128.0	135.0	136.0	130.0
2	74.0	84.0	84.0	88.0	91.0	105.0	100.0	72.0
3	106.0	101.0	148.0	124.0	95.0	122.0	116.0	102.0
4	71.0	59.0	45.0	4.0	4.0	4.0	4.0	4.0
5	112.0	110.0	118.0	99.0	106.0	104.0	105.0	106.0
6	74.0	75.0	54.0	4.0	4.0	4.0	4.0	4.0
7	106.0	115.0	114.0	117.0	113.0	105.0	4.0	4.0
8	82.0	87.0	4.0	4.0	4.0	4.0	4.0	4.0
9	124.0	114.0	117.0	89.0	125.0	127.0	111.0	122.0
10	95.0	102.0	110.0	115.0	112.0	122.0	112.0	105.0
11	109.0	111.0	120.0	44.0	121.0	111.0	126.0	124.0

EXPERIMENT 3

MEAN THIRD SEGMENT (POSTPUNISHMENT) SPEEDS OF GUILLOTINE-DOOR SUBJECTS

GOALBOX CRITERION
CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	83.0	86.0	81.0	75.0	73.0	69.0	67.0	65.0
2	102.0	122.0	121.0	100.0	22.0	4.0	4.0	4.0
3	43.0	53.0	37.0	47.0	47.0	55.0	4.0	4.0
4	26.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	65.0	29.0	52.0	30.0	4.0	4.0	4.0	4.0
6	42.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	45.0	45.0	37.0	6.0	4.0	4.0	4.0	4.0
8	81.0	65.0	68.0	70.0	66.0	83.0	18.0	4.0
9	60.0	84.0	47.0	4.0	4.0	4.0	4.0	4.0
10	37.0	44.0	22.0	23.0	4.0	4.0	4.0	4.0
11	45.0	29.0	33.0	13.0	4.0	4.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	46.0	52.0	71.0	69.0	64.0	83.0	85.0	77.0
2	37.0	54.0	49.0	56.0	29.0	4.0	4.0	4.0
3	40.0	50.0	61.0	58.0	70.0	12.0	4.0	4.0
4	36.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	62.0	59.0	70.0	61.0	54.0	52.0	45.0	52.0
6	93.0	107.0	131.0	133.0	126.0	135.0	131.0	121.0
7	69.0	77.0	64.0	4.0	4.0	4.0	4.0	4.0
8	44.0	34.0	4.0	4.0	4.0	4.0	4.0	4.0
9	32.0	53.0	58.0	46.0	67.0	78.0	69.0	4.0
10	97.0	81.0	101.0	65.0	70.0	64.0	81.0	51.0
11	67.0	52.0	69.0	68.0	56.0	57.0	88.0	75.0

EXPERIMENT 3

MEAN THIRD SEGMENT (POSTPUNISHMENT) SPEEDS OF DROP-START SUBJECTS

GOALBOX CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	64.0	77.0	89.0	71.0	84.0	81.0	38.0	47.0
2	60.0	83.0	60.0	25.0	8.0	4.0	4.0	4.0
3	96.0	94.0	37.0	22.0	4.0	4.0	4.0	4.0
4	88.0	80.0	90.0	81.0	49.0	23.0	4.0	4.0
5	84.0	78.0	88.0	60.0	4.0	4.0	4.0	4.0
6	119.0	124.0	113.0	79.0	13.0	4.0	4.0	4.0
7	75.0	83.0	100.0	81.0	77.0	92.0	23.0	4.0
8	62.0	71.0	60.0	56.0	49.0	29.0	4.0	4.0
9	51.0	86.0	83.0	79.0	84.0	99.0	12.0	13.0
10	35.0	42.0	37.0	25.0	4.0	4.0	4.0	4.0
11	42.0	53.0	37.0	32.0	37.0	15.0	4.0	4.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	104.0	136.0	117.0	124.0	132.0	114.0	114.0	90.0
2	42.0	42.0	39.0	42.0	43.0	57.0	48.0	38.0
3	74.0	88.0	140.0	114.0	88.0	110.0	94.0	80.0
4	40.0	39.0	23.0	4.0	4.0	4.0	4.0	4.0
5	117.0	108.0	100.0	87.0	92.0	85.0	100.0	87.0
6	71.0	56.0	39.0	4.0	4.0	4.0	4.0	4.0
7	47.0	55.0	73.0	62.0	53.0	66.0	4.0	4.0
8	48.0	52.0	4.0	4.0	4.0	4.0	4.0	4.0
9	114.0	112.0	111.0	119.0	127.0	134.0	129.0	135.0
10	37.0	29.0	45.0	60.0	55.0	55.0	75.0	46.0
11	95.0	85.0	110.0	101.0	107.0	100.0	113.0	103.0

EXPERIMENT 3

PREPUNISHMENT CRITERION

MEAN STARTING SCORES OF GUILLOTINE-DOOR SUBJECTS

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	59.9	50.8	38.5	60.5	107.0	94.4	108.0	102.0
2	56.7	75.1	21.0	27.7	49.5	26.1	36.8	91.7
3	68.5	66.8	86.5	85.7	60.5	63.0	76.2	108.0
4	23.3	60.9	0.7	0.7	0.7	0.7	0.7	0.7
5	59.7	66.5	75.1	67.2	62.0	31.3	75.5	81.9
6	0.9	0.7	0.7	0.7	0.7	0.7	0.7	0.7
7	42.0	48.6	55.3	59.0	72.2	76.4	88.6	84.5
8	38.2	27.6	39.2	33.5	74.4	94.4	44.0	53.5
9	80.6	79.3	36.7	74.3	87.7	0.7	0.7	0.7
10	26.9	59.7	53.3	35.7	84.5	26.9	33.6	31.8
11	65.0	50.7	82.3	65.9	67.0	95.8	54.4	39.7

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	53.2	41.8	52.7	64.7	53.4	44.2	47.2	35.2
2	26.0	30.8	34.1	24.5	22.2	0.7	0.7	0.7
3	46.5	52.8	41.9	47.7	57.8	47.5	46.7	43.7
4	11.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7
5	70.8	77.4	82.3	87.5	64.5	94.4	72.8	55.1
6	14.4	13.5	19.0	22.4	19.0	9.5	18.2	14.2
7	67.9	90.9	87.7	0.7	0.7	0.7	0.7	0.7
8	1.8	1.1	0.7	0.7	0.7	0.7	0.7	0.7
9	27.7	60.1	53.9	45.5	54.5	28.6	22.6	0.7
10	81.3	50.4	40.7	44.8	63.0	55.6	54.3	47.3
11	33.0	6.7	1.4	1.0	8.6	0.7	0.7	0.7

EXPERIMENT 3

MEAN STARTING SCORES OF DROP-START SUBJECTS

PREPUNISHMENT CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	76.2	97.9	93.2	65.7	101.0	84.9	90.6	102.0
2	67.7	82.3	82.4	61.7	113.0	108.0	73.1	95.8
3	74.0	91.7	94.4	54.5	82.8	61.7	69.9	59.4
4	45.5	68.5	90.8	63.4	108.0	70.3	100.0	113.0
5	44.3	99.1	77.4	82.3	90.8	117.0	100.0	95.8
6	90.6	95.1	122.0	119.0	87.5	94.4	100.0	57.1
7	29.0	32.1	31.5	22.3	35.3	29.9	38.5	29.4
8	105.0	42.0	57.5	68.7	82.3	84.9	100.0	74.4
9	68.5	90.5	114.0	99.1	102.0	95.8	43.9	91.7
10	45.5	57.9	81.5	51.5	46.7	2.3	0.7	0.7
11	43.3	47.3	66.0	75.1	39.9	78.0	77.4	68.8

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	68.2	89.6	122.0	140.0	84.9	87.8	112.0	87.2
2	55.9	57.6	68.4	62.7	53.8	29.4	64.7	36.5
3	69.8	54.6	32.8	52.1	75.3	61.3	67.0	44.9
4	68.9	57.8	50.2	46.5	56.6	22.3	48.5	40.4
5	95.8	91.7	89.2	105.0	94.9	93.5	83.3	91.7
6	57.4	86.5	58.5	0.7	0.7	0.7	0.7	0.7
7	67.9	90.9	87.7	119.0	113.0	94.4	0.7	0.7
8	95.8	83.3	0.7	0.7	0.7	0.7	0.7	0.7
9	35.6	37.6	29.6	81.5	61.6	77.8	84.5	80.4
10	97.9	50.4	109.0	44.8	97.9	86.1	100.0	108.0
11	53.1	117.0	119.0	113.0	113.0	117.0	97.9	97.9

EXPERIMENT 3

MEAN FIRST SEGMENT (PREPUNISHMENT)
SPEEDS OF GUILLOTINE-DOOR SUBJECTS

PREPUNISHMENT
CRITERION

NONPUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	82.0	103.0	83.0	84.0	86.0	87.0	82.0	71.0
2	104.0	118.0	103.0	82.0	77.0	61.0	65.0	111.0
3	74.0	69.0	69.0	66.0	71.0	49.0	63.0	77.0
4	42.0	45.0	4.0	4.0	4.0	4.0	4.0	4.0
5	87.0	54.0	84.0	53.0	73.0	87.0	91.0	77.0
6	38.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
7	65.0	55.0	50.0	34.0	7.0	36.0	45.0	50.0
8	105.0	99.0	85.0	78.0	63.0	85.0	38.0	61.0
9	66.0	81.0	81.0	4.0	21.0	4.0	4.0	4.0
10	92.0	68.0	38.0	14.0	31.0	37.0	34.0	29.0
11	39.0	29.0	72.0	59.0	68.0	43.0	52.0	25.0

PUNISHED SUBJECT	EXTINCTION DAY 1	2	3	4	5	6	7	8
1	100.0	120.0	119.0	123.0	128.0	127.0	138.0	124.0
2	85.0	102.0	115.0	105.0	58.0	4.0	4.0	4.0
3	51.0	66.0	80.0	73.0	99.0	84.0	88.0	81.0
4	64.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	82.0	84.0	93.0	89.0	84.0	85.0	86.0	83.0
6	119.0	134.0	158.0	161.0	153.0	170.0	153.0	127.0
7	88.0	102.0	77.0	4.0	4.0	4.0	4.0	4.0
8	88.0	65.0	4.0	4.0	4.0	4.0	4.0	4.0
9	46.0	66.0	16.0	55.0	76.0	91.0	85.0	4.0
10	86.0	69.0	89.0	78.0	90.0	94.0	103.0	81.0
11	67.0	25.0	81.0	58.0	47.0	58.0	90.0	49.0

EXPERIMENT 3

MEAN FIRST SEGMENT (PREPUNISHMENT) SPEEDS OF DROP-START SUBJECTS

PREPUNISHMENT CRITERION

EXTINCTION DAY

NONPUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	111.0	125.0	137.0	107.0	123.0	137.0	92.0	109.0
2	91.0	108.0	112.0	81.0	70.0	70.0	44.0	39.0
3	91.0	93.0	43.0	36.0	26.0	9.0	7.0	6.0
4	88.0	90.0	96.0	99.0	82.0	28.0	41.0	16.0
5	96.0	101.0	99.0	69.0	74.0	61.0	78.0	67.0
6	102.0	100.0	100.0	85.0	48.0	93.0	65.0	51.0
7	95.0	106.0	103.0	86.0	105.0	51.0	38.0	38.0
8	67.0	78.0	89.0	91.0	94.0	68.0	65.0	88.0
9	93.0	112.0	114.0	99.0	112.0	122.0	51.0	26.0
10	46.0	50.0	50.0	31.0	112.0	10.0	4.0	4.0
11	90.0	88.0	91.0	66.0	78.0	53.0	41.0	51.0

EXTINCTION DAY

PUNISHED SUBJECT	1	2	3	4	5	6	7	8
1	115.0	126.0	131.0	126.0	128.0	135.0	136.0	130.0
2	74.0	84.0	84.0	88.0	91.0	105.0	100.0	72.0
3	106.0	101.0	148.0	124.0	95.0	122.0	116.0	102.0
4	71.0	59.0	45.0	4.0	68.0	116.0	106.0	88.0
5	112.0	110.0	118.0	99.0	106.0	104.0	105.0	106.0
6	74.0	75.0	54.0	4.0	4.0	4.0	4.0	4.0
7	106.0	115.0	114.0	117.0	113.0	105.0	4.0	4.0
8	82.0	87.0	4.0	4.0	4.0	4.0	4.0	4.0
9	124.0	114.0	117.0	89.0	125.0	127.0	111.0	122.0
10	95.0	102.0	110.0	115.0	112.0	122.0	112.0	105.0
11	109.0	111.0	120.0	44.0	121.0	111.0	129.0	124.0