ALCOHOL AS A DISCRIMINATIVE STIMULUS
FOR SELF-PUNITIVE BEHAVIOR IN THE RAT
DURING SUCCESSIVE-DISCRIMINATION "EXTINCTION" TRIALS

by

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A THESIS

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INTRODUCTION

During the past few years a considerable amount of interest has been shown in the phenomenon of self-punitive or vicious-circle behavior in both rat and human subjects (e.g. Brown, 1969; Brown, Martin, & Morrow, 1964; Delude, 1969; Delprato & Denny, 1968; Dreyer & Renner, 1971; Martin, Deemer, McArdle, Stokely, & Steiner, 1971; Melvin, 1971; Skurdal, Eckardt, & Brown, 1975). A self-punitive experiment with rats typically consists of a shock-escape training phase (avoidance training may be used) in a short straight runway, followed by an "extinction" or testing phase. The components of the runway are generally a starting section, several alley segments, and a goalbox. During the shock-escape training phase animals learn to leave the electrified starting section, traverse the electrified alley segments, and enter the nonelectrified goalbox. During the "extinction" or testing phase, animals are divided into at least two groups, one of which is no longer shocked anywhere in the runway. Nonshocked subjects tend to slacken running speeds, engage with increasing frequency in behaviors other than running (e.g. exploration, grooming, stretching, etc.), and ultimately fail to run toward the goalbox. When the rapid locomotion characteristic of the shock-escape training phase and early extinction trials has ceased, that behavior is said to have extinguished (hence the label "'extinction' phase"). For another group of subjects shock is not present in the runway except for a segment somewhere between the start and goal boxes. Thus these rats are shocked in an intermediate segment of the alley if, but only if, they run from the starting section and earlier alley segments. Because experiencing the shock of an intermediate segment is contingent upon the animal's leaving the starting and initial segments, and because shock is a stimulus to which rats are normally averse, the shock is called "punishment." Animals that are punished in this fashion typically continue to run rapidly through the alley for extended numbers of trials, often for more trials than nonpunished rats. The tendency of punished rats to persist in running, at higher speeds for more trials than nonpunished rats, from a "safe" region into and across a region where a noxious stimulus is encountered has been called masochistic-like, self-punitive, and vicious circle behavior (Brown, 1965, 1969; Brown, Beier, & Lewis, 1971; Brown et al., 1964; Melvin, 1971; Mowrer, 1947, 1960).

One traditional explanation of self-punitive behavior relies on conditioned fear as the principal motivation for running during the "extinction" phase. It is assumed that fear elicited by the cues of the starting and initial segments causes the animals to leave those areas and to run toward the goalbox. If the grids of an intermediate region are electrified, the shock onset reconditions the previously elicited fear and the shock offset which accompanies movement into the final segment or goalbox reinforces the running. Entry into the goalbox is reinforced by the offset of fear-evoking cues of earlier segments. The result is that nonpunished animals soon slow and cease running while punished animals continue to run swiftly for extended numbers of trials. (Cf. Brown, 1965, 1969; Melvin, 1971; Mowrer, 1947.)

One alternative that has been offered in lieu of the conditioned fear hypothesis is the "discrimination" hypothesis. In one form of this hypothesis, Church (1963) suggested that facilitation of running for animals punished during the "extinction" phase occurs because of reinstatement, for those animals, of specific stimuli (e.g. shock) present earlier in the training phase; no such reinstatement occurring for non-punished subjects. In another form of the "discrimination" hypothesis (Dreyer & Renner, 1971; Mowrer, 1960) it is maintained that the rat involved in vicious circle behavior continues to run because it is confused and does not discriminate the fact that shock has been removed from the starting and early segments but not from an intermediate segment. It should be noted that while Mowrer (1960) relies on a failure to discriminate to explain why punished animals do not stop running ("It is only when they cannot distinguish between the starting and the shock areas of the runway that they get into and persist in the 'vicious circle.'", p. 487), he also relies on conditioned and generalized fear to explain why they run at all ("Each time the rat is put into the beginning end, it is so afraid that it is driven out of that end, in the direction of the safety compartment, despite the fact that its route takes it over the energized portion of the floor.", p. 486). Dreyer and Renner (1971) also suggest that the discrimination and conditioned-fear hypotheses are not necessarily incompatible.

However, one operation for which the alternative explanations seem to demand differing outcomes is the introduction of stimuli during the "extinction" phase which are perfectly correlated with punishment. In general, discrimination hypotheses seem to predict that the rat will not continue to run if distinctive cues are presented to it that indicate whether shock will be encountered in the runway. Mowrer (1960) has suggested that when the starting sections and the shock segment are quite visibly different, subjects are prone to wait in the starting sections and thus find out that they are "safe" there. On the other hand, Brown (1970) has reported evidence to indicate that under certain conditions the presence of distinctive cues denoting the presence or location of punishment will result in more pronounced vicious circle behavior than would be observed in the absence of such cues.

In an attempt to test these differing predictions, Crowell, Brown, and Lewis (1972) presented rats with a tone of one frequency (CS_{sk}) on trials when shock was present in the middle segment and with a tone of another frequency (CS_{nsk}) when shock was absent. The results of this successive discrimination procedure indicated that signalling the impending shock failed to slow or stop running. Instead, the self-punitive effect was obtained for the first time in a within-subjects design, being defined therein as faster running on CS_{sk} trials than on CS_{nsk} trials. Crowell et al. (1972) interpreted the results as being consistent with the supposition that the CS_{sk} became a fear-arousing stimulus which motivated the rats to run, as predicted by conditioned-fear theory.

The effects of the Crowell et al. (1972) experiment, though significant, might have been materially altered if the CS_{sk} and CS_{nsk} had differed more from one another. It could be argued by a discrimination theorist that the stimuli used by Crowell et al. (1972) did come to elicit differential degrees of fear but were still not distinctive enough to serve as cues for discriminatory locomotor reactions (e.g. running vs. stopping). If one also assumes that learning the discrimination or "becoming aware" of impending punishment will slow or stop running, then perhaps more distinctive cues will produce different results than those observed by Crowell et al. (1972).

The recent assertion by Overton (1971) that centrally acting drugs are more effective as cues in discrimination paradigms than are external sensory stimuli suggests that a more sensitive test of the prediction of a discrimination hypothesis for the effect of signalling impending shock on self-punitive running would be provided by the use of drug-produced stimuli in place of external cues. The primary evidence on which Overton (1971) based his assertion was apparently generated in an experiment which was part of his Ph.D. dissertation (Overton, 1964, Experiment 5). In that experiment a direct comparison was made of the effectiveness of a variety of agents in controlling differential responses. Testing was done in a T maze with the wire grid floor electrified throughout except in the goal boxes. Rats were trained to turn one direction in the presence of the agent and the other direction in its absence in order to escape shock, with access to the "wrong" goalbox blocked. The results showed clearly that pentobarbital versus no drug produced differential responding more quickly than all other sets of cues. The notion that centrally acting drugs, in particular the anesthetic depressants, are effective as discriminative stimuli has been supported by further research, compiled and summarized by Overton (1971).

While the possible mechanisms for discriminative control of behavior by drugs provide interesting bases for conjecture and are certainly worth investigating, the thrust of the present research is not in that direction. Suffice it to say that there are at least three alternative means by which drugs might acquire discriminative control. (a) Drug effects outside sensory systems might produce response control. With respect to this hypothesis, Overton's (1971) observation that "there is no direct evidence to either support or negate the hypothesis that drugs acquire response control by virtue of some central process which is independent of sensory control" (p. 106) is still true. (b) Drugs might acquire response control by inducing distinctive sensory cues. Such interoceptive stimulus control is difficult to differentiate experimentally from the third hypothesis, (c), which suggests that drugs acquire response control by affecting normal sensory processes (e.g. raising or lowering sensory thresholds). In any event, discriminative control involves a behavioral relation between environmental events and responses. Demonstrating the relation does not require a choice between the above alternative means. Further, once discriminative control has been demonstrated, subsequent revelations about its mechanism do not alter the behavioral status of the relation. (Cf. Catania, 1971.) With respect to mechanism, the experimental design used herein does not provide any basis for supporting or contesting the available hypotheses.

Ethyl alcohol is among the drugs which have been shown to exert strong control over behavior in various discrimination paradigms (Barry, Koepfer, & Lutch, 1965; Conger, 1951; Korman, Knopf, & Leon, 1962;

Overton, 1972). If, as Overton (1971) has concluded, centrally acting drugs are more effective as cues in discrimination paradigms than are sensory stimuli; and if, as Brown (1970) suggests, stimuli that are correlated with punishment may enhance self-punitive running; and if, as Crowell et al. (1972) have demonstrated, rats can be induced to run when signalled-punishment trials are intermixed with regular extinction trials; then it is possible that using sobriety and alcohol[1]-induced intoxication as CS_{sk} and CS_{nsk} in a self-punitive paradigm might produce results similar to, but more pronounced than those obtained by Crowell et al. (1972). On the other hand, if the cues which signal punishment are distinct enough, perhaps rats will discriminate the presence of impending shock on those trials, á la Dreyer and Renner (1971), and stop running.

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[1]Throughout this manuscript, the terms "ethyl alcohol," "alcohol," and "ethanol" will be used interchangebly. Appropriate details about the alcohol solutions are supplied under "Method:" p. 12 and p. 42.

EXPERIMENT 1

The experiment was designed in an effort to study self-punitive behavior using a within-subjects design in which the presence and absence of ethyl alcohol served for some animals as a reliable correlate of punishment or no punishment. Three groups of rats were employed. All three were given shock-escape training trials for several days, some trials ensuing after the animals had drunk alcohol in sugar water and some trials ensuing after they had drunk only sugar water. During the "extinction" phase the rats of one group were given punished (P) trials on days when they had drunk alcohol (A) and nonpunished (NP) trials on days when they had drunk sugar water (S). This group, then, was called AP-SNP (alcohol-punished--sugar water-nonpunished). For a second group, punished trials were administered on days when sugar water was consumed, nonpunished trials on alcohol days (SP-ANP; sugar water-punished--alcohol-nonpunished). For a third group (AS-PNP; alcohol-sugar water--punished-nonpunished), the fluid consumed and subsequent drug state (or lack thereof) were not consistently related to shock punishment or its absence. On half the days of alcohol consumption and half the days of sugar water consumption these animals were scheduled for punished trials; on all other days nonpunished trials were administered. Thus the drunk and sober states can be compared to the high and low tones used by Crowell et al. (1972); and the experiment can be described as an investigation of what happens to locomotor performance in a short straight runway when response contingent shock is delivered in conjunction with a state of intoxication (or sobriety) and no shock-punishment is paired with sobriety (or inebriation). If the processes which produced the self-punitive effect observed by Crowell et al. (1972) operate here, subjects should run faster when the drug state signals impending shock than when no shock is signalled or when drug state is not a reliable signal.

Method

Subjects

The subjects were 15 naive female albino rats (Sprague-Dawley derivatives from Carworth Farms, Inc., Portage, Michigan), 60 days of age upon arrival in the laboratory. Of an original 17, two subjects were discarded because of inadvertant administration of shock during what should have been nonpunished extinction trials. The rats were housed under constant temperature conditions (24^{o} C) and a 12 h day-night cycle, four or five animals per large cage for 32 days, with water and laboratory chow available ad lib. On the 33d day they were moved to individual cages and randomly assigned to one of the treatment conditions. Thereafter they were maintained on a fluid deprivation schedule which allowed 10 min access to fluid early in the dark half of the day-night cycle. Because the rats were run in squads (as described under "Procedure"), the starting times of the drinking sessions varied between squads but fluid deprivation time for each animal remained relatively constant at about 23 h 50 min. Alcohol and sugar water solutions were substituted for tap water during this 10 min period when required by the experimental design. Laboratory chow was available ad lib. in the home cage throughout the experiment.

Apparatus

The apparatus consisted of a grid-floored alley (183 cm long, 11.4 cm wide, 20.3 cm deep), a grid-floored starting section (38 cm long, 11.4 cm wide, 20.3 cm deep) surmounted by a trap-door-floored startbox (22.4 cm long, 10.2 cm wide, 18 cm deep), and a large goalbox (45.7 cm long, 25 cm wide, 19.8 cm deep). The floor of the startbox was hinged at the end most distal to the goalbox, 30.5 cm above the floor of the starting section, so that when it was released it dropped to a vertical position against the wall of the starting section. The walls and floor of the goalbox were painted with black and white squares (2.54 cm on a side) in a checkerboard pattern, whereas the walls of the runway and the subflooring beneath the grid were painted medium grey. A guillotine door separated the goalbox from the alley. Hinged Plexiglas lids covered the entire apparatus. Figure D, p. 116, is a diagram of the runway.

Sets of photocells and infrared light sources were located at the beginning of the alley and at intervals of 61 cm thereafter. The photocells, three at each position, were mounted in the side walls of the runway 2.5 cm, 5.2 cm, and 10.2 cm above the grid floor, and were energized by three infrared light sources in the opposite wall. These devices, associated electronic equipment, and a PDP8/F computer provided measurements (to the nearest .02 sec) of starting time (the interval between release of the startbox floor and occlusion of the first light beam) and time spent in each 61-cm segment of the alley.

The grid floors, fashioned of 2.4 mm stainless steel rods spaced at 1.27 cm intervals, were energized by a 60-Hz current controlled by a variable voltage autotransformer and fed through a series resistance of 10 kΩ. A voltmeter, connected across the grids at all times, was used to monitor shock intensity. It had a full-scale calibration of 150 V ac and a sensitivity of 2000 Ω/V. Throughout all phases of this experiment the shock voltage was set to a nominal 55 V.

Procedure

The procedure involved an initial phase of shock-escape training for all subjects under both drugged and nondrugged conditions. Subsequent to that training, treatments differed according to group assignment. For one group (AP-SNP), alcohol was consumed on days of punished trials, sugar water on days of nonpunished trials. For another group (SP-ANP), consumption of sugar water was followed by punished trials, and consumption of alcohol was followed by nonpunished trials. The third group (AS-PNP) received nonpunished "extinction" trials and punished "extinction" trials in a manner not predicted by their drug state. That is, on half the days when alcohol was consumed and on half the days when sugar water was consumed, punished trials ensued. On all other days regular extinction trials occurred. The alcohol and sugar water solutions were offered on successive days in an ASSASAAS sequence. Half the animals of each group were run on a counterbalanced, or SAASASSA schedule. Because punished trials were correlated with alcohol for the alcohol-punished--sugar water-nonpunished (AP-SNP) group, the punished trials occurred in the same sequence as alcohol consumption. Similarly, for the sugar water-punished--alcohol-nonpunished (SP-ANP) group nonpunished trials occurred in the same sequence as the consumption of alcohol.

Three trials were conducted each day, so the ABBA sequence for punished and nonpunished trials describes the order of occurrence of sets of three trials of each sort. For the animals of the AS-PNP group, punished trials occurred in either a ØPØPPØPØ sequence or the counterbalanced PØPØØPØP sequence, so that on alternate days of trials under each drug condition, the punishment contingency was varied with nonpunishment.

Subjects were run in squads of five and six, with animals from each experimental group distributed as equally as possible between squads. Trials began each day 10 min after the end of the drinking period. Successive members of any one squad were run at intervals of approximately 60 sec; trials generally consumed about 40 sec. The interval between trials for each subject was about 6 min. Each day for the first 5 days after being moved to individual cages and placed on a fluid deprivation regimen, the animals were handled individually for 2 min, weighed, and given the opportunity to drink water from a drinking tube in their home cages for 10 min. On Days 6 and 7 the subjects were weighed and offered either alcohol or sugar water. Half the subjects were offered alcohol on Day 6 and sugar water on Day 7, the other half were offered sugar water on Day 6 and alcohol on Day 7. The sugar water was a mixture of 40 g of granulated cane sugar in tap water at room temperature to a volume of 500 ml. The alcohol solution was comprised of 40 g of granulated cane sugar, 25 ml of 95% ethyl alcohol, and room temperature tap water to a volume of 500 ml (a 4.75% v/v solution). Immediately upon completion of the 10 min drinking period the subjects were placed in a small compartment (10 cm wide, 15.2 cm long, 15 cm deep) of a carrying box and transported to the experimental room. At the end of a 10 min interval following completion of the drinking session, trials began in which the animals were habituated to the goalbox for a total of 2 min. Each rat was placed into the goalbox four times, once in each corner, being free to explore for 30 sec. After each placement and removal the rat was returned to the carrying box, there to remain while the other members of the squad were allowed to explore the goalbox. Thus the interval between successive 30 sec goalbox placements was approximately 5 min.

Shock-escape shaping trials, consisting of six trials involving progressively longer segments of the runway, were administered on Days 8 and 9. On each trial an animal was placed in the startbox and the Plexiglas lid was secured. The trap door was released 3 sec later, dropping the animal onto the electrified grid of the runway. When the animal had traversed the runway and entered the goalbox the guillotine door was lowered. After 30 sec in the goalbox the subject was removed to its carrying box. For the first trial on Day 8, the start box was placed next to the goalbox so that the animals could reach safety after traversing only 10 cm of electrified grid. On the second and third trials the rats had to cross an additional 61 cm to reach the goalbox. On the first trial of Day 9 subjects were again required to cross 71 cm of electrified grid to reach the safety of the goalbox. The second and third trials of Day 9 involved a runway length of 122 cm. Days 10 through 13 involved additional shock-escape training (full length runway) with three trials given per day. On Days 8 through 13 the fluid alternation schedule was SASAAS for half the animals, ASASSA for the other half.

On Day 14 extinction conditions were initiated. Subjects received three punished or nonpunished trials each day, as appropriate to their drug condition and group schedule. On nonpunished trials animals received no shock in any portion of the runway, whereas on punished trials they received shock in the middle 61 cm segment of the alley. Rats failing to enter the goalbox within 60 sec on any trial were removed from the runway and placed in the goalbox, there to remain for 30 sec. They were then removed to the carrying box and the next squad member was run. Recorded times for all segments completed were used as data, and 15 sec times were assigned for each segment not completed. When a subject's median latency for each segment (excluding the starting section time) reached 15 sec on consecutive days under each drug condition, 15 sec times were assigned for the start and alley segments for all subsequent days of experimentation and the subject was not run again. This extinction criterion meant that failure to "trip" the photocell marking the beginning of the middle segment (the shock zone on punished trials) within 60 sec of flap drop on two of three trials under drugged <u>and</u> nondrugged conditions resulted in the subject's being eliminated from further experimentation.

In summary, then: The experiment was conducted on consecutive days. Initiation of the fluid deprivation regimen occurred on Day 1, with the subsequent 4 days devoted to handling the animals and allowing them to adjust to the deprivation schedule. Days 6 and 7 involved exposure to the alcohol and sugar water solutions, and goalbox habituation. Shock-escape shaping trials, in which alley length increased progressively, occurred on Days 8 and 9. The shock-escape training phase, with full length runway trials, occupied Days 10 - 13. With three trials per rat each day, shock-escape training consisted of 12 full length trials. Days 14 - 37 were the "extinction" phase (a total of 72 "extinction" trials for each rat). Half of those trials ensued after rats drank alcohol, half after sugar water. One group (AP-SNP) ran into punishment in the middle segment on every trial when intoxicated, but encountered no punishment when sober. A second group (SP-ANP) ran into punishment in the middle segment on every trial when sober, but encountered no punishment when drunk. The third group (AS-PNP) encountered punishment on half its trials subsequent to drinking alcohol, and on half its trials subsequent to drinking sugar water. The other half of "extinction" phase trials for AS-PNP rats were nonpunished trials.

Results

Shock-Escape Acquisition Data

Daily three-trial median running times were determined for each animal for the starting section and for each of the three alley segments for each of the four days of shock-escape training. Data were then grouped in accordance with the ABBA schedule for administering the alcohol and sugar water solutions, and mean scores were computed for each animal for each solution. Thus two scores were available for each animal in each alley segment: mean running speeds after alcohol and after sugar water consumption. These speeds served as the basic data in the analysis of variance of performances during acquisition.

Mean speeds in each of the three alley segments under conditions of alcohol and sugar water are shown in Figure 1. The main effect of drug condition was significant in every segment [initial segment: $F(1,12) = 7.23$, $p < .05$; middle segment: $F(1,12) = 10.63$, $p < .01$; final segment: $F(1,12) = 18.07$, $p < .01$]. Differences between subsequently differentiated groups were not significant in any segment, nor was the interaction between future treatment group assignment and drug condition significant. Analysis of speeds in the starting section (listed in Appendix A) revealed no significant differences.

Extinction Data

Daily median running times were extracted as with acquisition data. Data were converted to speeds, grouped in blocks of four days in accordance with the ABBA schedule for response-contingent shock, and mean scores were computed for all animals in each punishment condition. Thus for each block of four days (three punished trials per day for two days and three nonpunished trials per day for two days in an ABBA or BAAB sequence), two scores were available for each animal in each segment: mean running speeds on punished and on nonpunished trials. These speed scores served as the basic data in the analyses of variance of performance during extinction. In cases where running times were not available because of machine or operator error, dummy scores were calculated by averaging the last previous and next succeeding mean scores for trials of a similar nature for that animal. Thus if running time was

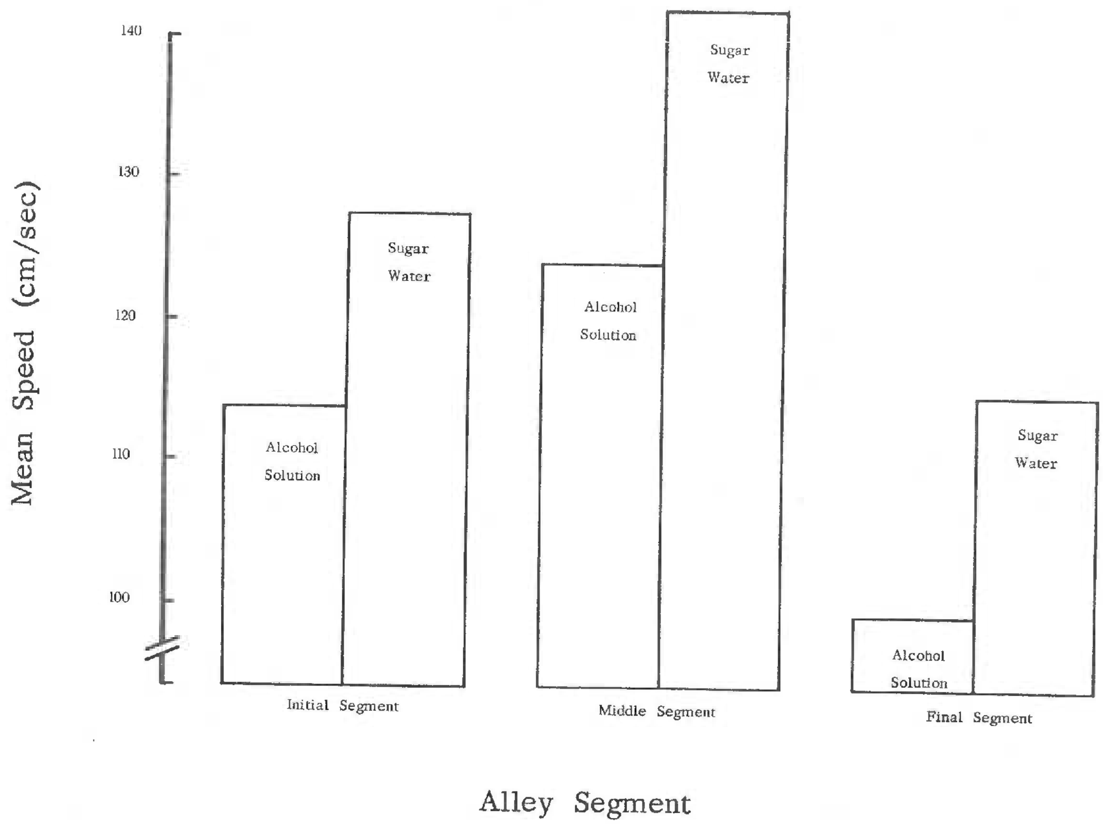

Figure 1. Effects of consumption of a 4.75% alcohol solution on running speeds during shock-escape training in all alley segments.

unavailable for the middle segment of a punished-alcohol trial, the middle segment speed from the last previous block of punished-alcohol trials and the next succeeding block of punished-alcohol trials for that animal were averaged to provide a dummy score. Such estimated scores comprised about three percent of the data.

Starting section speeds. Data from the starting section were analyzed with punishment as a factor in spite of the fact that no shock-punishment was administered in the starting section (or in the initial segment) to any animals during the extinction phase. Whether the drug state acquired CS-like properties would presumably be revealed by the significance of the punishment factor in contributing to the variance of running speeds in the starting section. Because animals did not encounter shock until they entered the middle segment, a separation of running speeds for AP-SNP and SP-ANP groups as a function of a "punishment" factor would be indicative of the importance of the drug state in controlling locomotion in these segments provided no such separation were to occur for the AS-PNP group. Such an effect of the "punishment" factor would be revealed in an interaction of punishment by treatment group.

An overall analysis of speeds in the starting section (three-way with factors of punishment, treatment group, and days) yielded only one significant outcome: an interaction of punishment by treatment group [$F(2,12) = 9.14$, $p < .01$]. The data which produced that interaction are portrayed in Figure 2, where it can be seen that speeds on trials with impending punishment (as compared to trials with no impending punishment) were faster for the SP-ANP group, but slower for the AP-SNP group, and

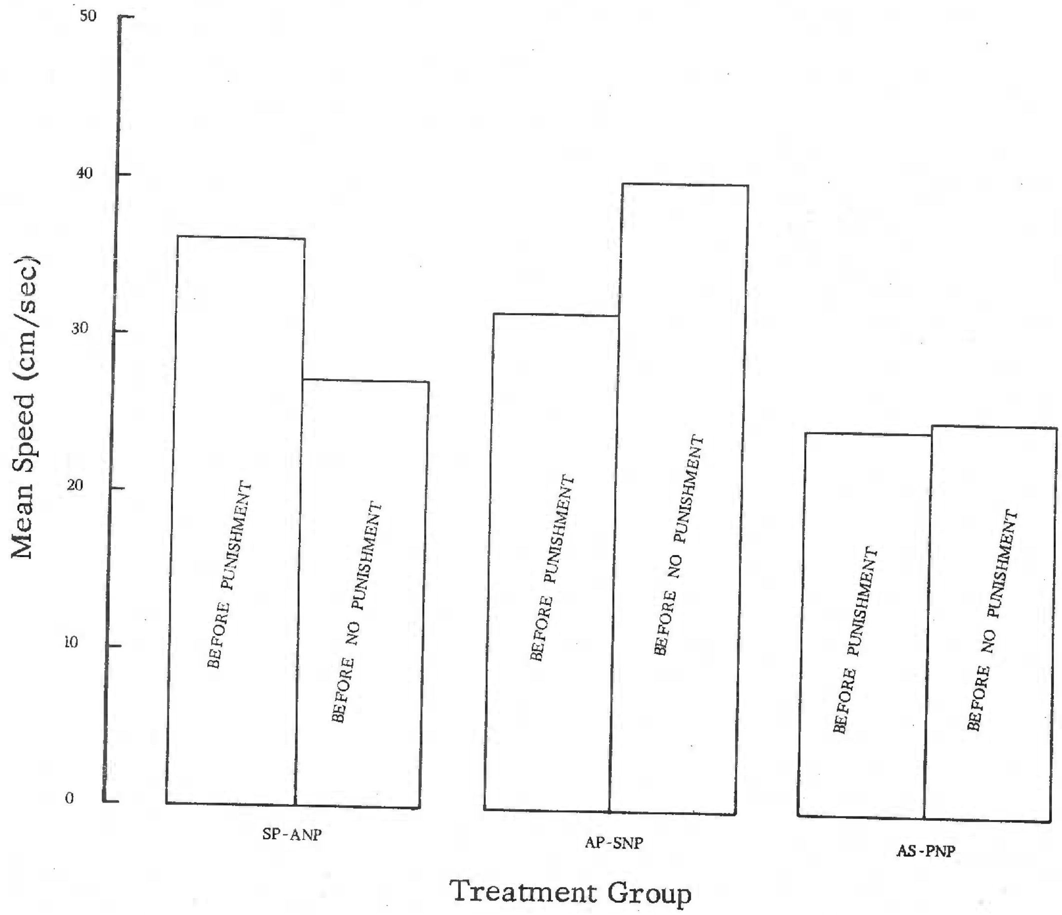

Figure 2. Starting section running speeds for each treatment group during extinction when either shock or no shock was present in the middle segment. SP-ANP animals drank sugar water on days of punished trials, 4.75% alcohol on days of nonpunished trials. AP-SNP animals drank 4.75% alcohol on days of punished trials, sugar water on days of nonpunished trials. Half the punished and half the non-punished trials were preceeded by sugar water consumption for the AS-PNP group; the other half of trials of each sort were preceeded by alcohol consumption.

insignificantly different (both practically and statistically) for the AS-PNP group. In addition, a Neuman-Keuls test (Winer, 1971) revealed that on nonpunished trials the AP-SNP animals were running faster than the SP-ANP animals on their punished trials, which were faster than AP-SNP animals on punished trials, which in turn were faster than rats in the remaining three conditions (all ps $< .01$). Speeds for the remaining three conditions did not differ significantly.

Alley segment speeds. Separate overall analyses were made of the speed data for each of the three alley segments. In the initial segment a main effect of punishment (P) was significant [$F(1,12) = 15.56$, $p < .01$]. It should be noted, as discussed in the preceeding section, that shock-punishment was administered only in the middle segment. Thus effects of the punishment factor in the initial segment occurred prior to punishment and effects of punishment in the final segment occurred subsequent to punishment. In addition to the P effect, a significant three-way interaction [$F(10,60) = 2.03$, $p < .05$] involved factors of treatment group (T), punishment (P), and days (D), in a manner which can be viewed as an interaction of days with a significant TP interaction [$F(2,12) = 18.13$, $p < .001$]. The change in the TP interaction over days is revealed in Figure 3, where the mean speeds of groups involved in the TPD interaction have been plotted. Two separate analyses of variance computed with data from the first and last blocks of days revealed a significant TP interaction [$F(2,12) = 5.62$, $p < .05$] but no significant main effects on the first block of four days, and a P effect [$F(1,12) = 4.34$, $p < .05$] as well as a TP interaction [$F(2,12) = 6.43$, $p < .05$] on

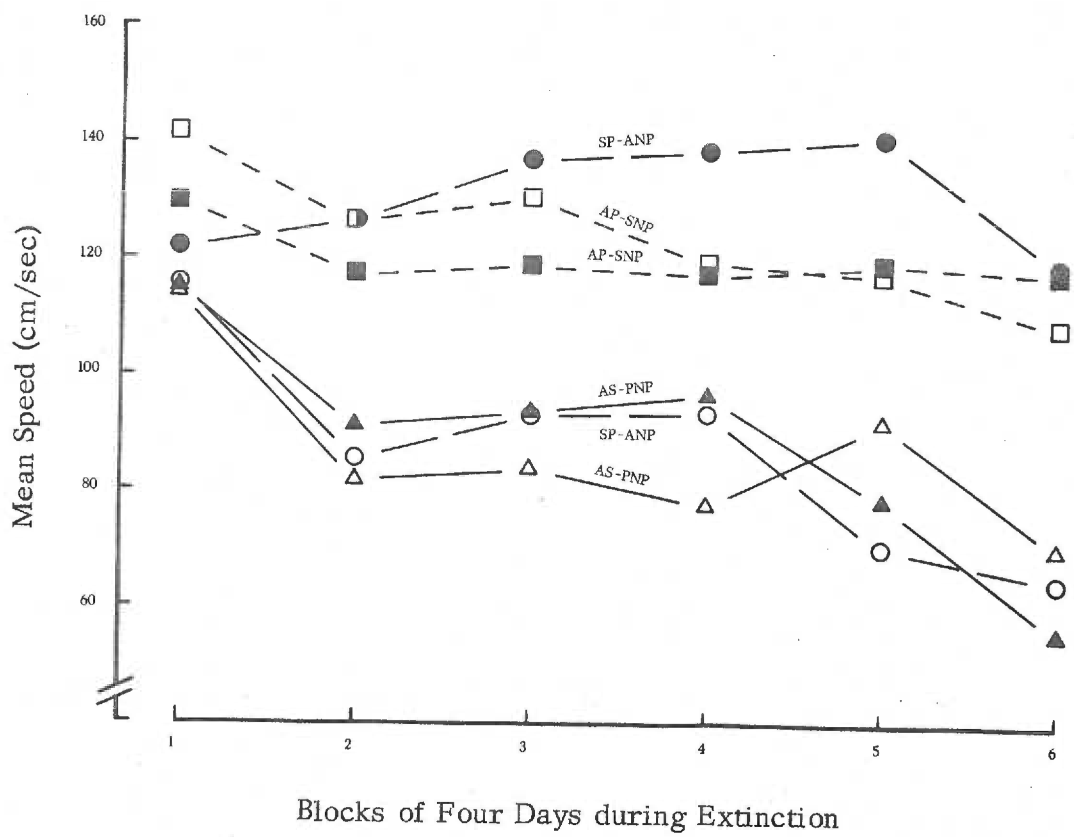

Figure 3. Running speeds through the initial segment during extinction. Filled symbols denote trials with shock-punishment impending in the middle segment; open symbols denote nonpunished trials. SP-ANP animals drank sugar water on days of punished trials, 4.75% alcohol on days of nonpunished trials. AP-SNP animals drank 4.75% alcohol on days of punished trials, sugar water on days of nonpunished trials. Half the punished and half the nonpunished trials followed sugar water consumption and half followed alcohol consumption for AS-PNP rats.

the final block of four days. A Newman-Keuls test revealed that on Block 1 of extinction the AP-SNP animals ran significantly faster on trials with no impending punishment than on trials with the punishment contingency. In addition, the AP-SNP animals ran faster on punished trials than the AS-PNP animals under either contingency and faster than the SP-ANP animals on nonpunished trials, but not faster than SP-ANP animals on punished trials. SP-ANP and AS-PNP animals did not differ significantly either when both were to be punished or when no punishment was impending. A Newman-Keuls test for the final block of days showed that the AP-SNP animals under both contingencies and the SP-ANP animals when punished differed significantly from animals in the other groups but not from each other. Both paired t tests and randomization tests for matched pairs (Siegel, 1956) were computed; both indicated that only one group, SP-ANP, and only on nonpunished trials, changed significantly in level of performance from the first to the last block of days.

In the middle segment significant interactions were limited to one: TP, $F(2,12) = 16.00$, $p < .001$. In addition, the main effects of punishment (P) and days (D) were significant [$F(1,12) = 87.06$, $p < .001$ and $F(5,60) = 2.66$, $p < .05$, respectively]. The effect of days can be seen in Figure 4, where the change in performance level, if one collapses across both treatment group and punishment factors, is a decrease in speed from early to later stages of extinction. The TP interaction is pictured in Figure 5. With the aid of a Newman-Keuls test it was determined that all differences

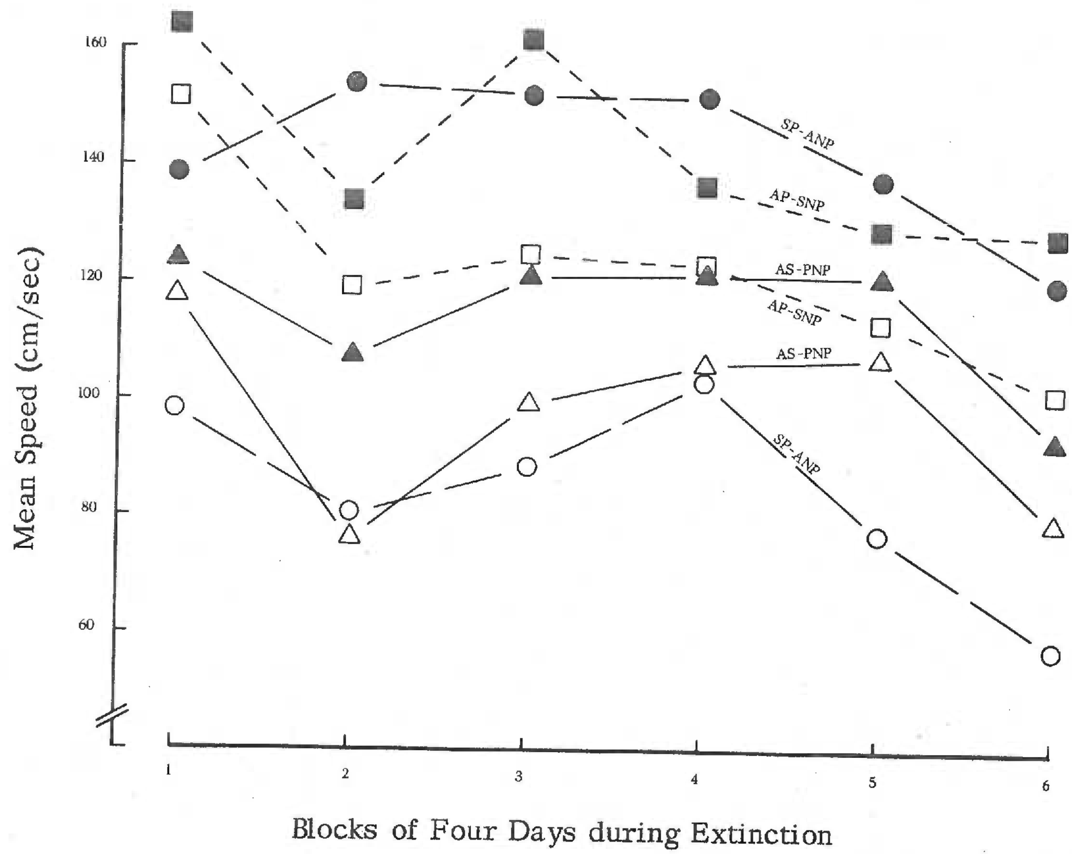

Figure 4. Mean running speeds over extinction days in the middle segment, by treatment group and punishment contingency. Filled symbols indicate trials on which shock-punishment was delivered in this segment.

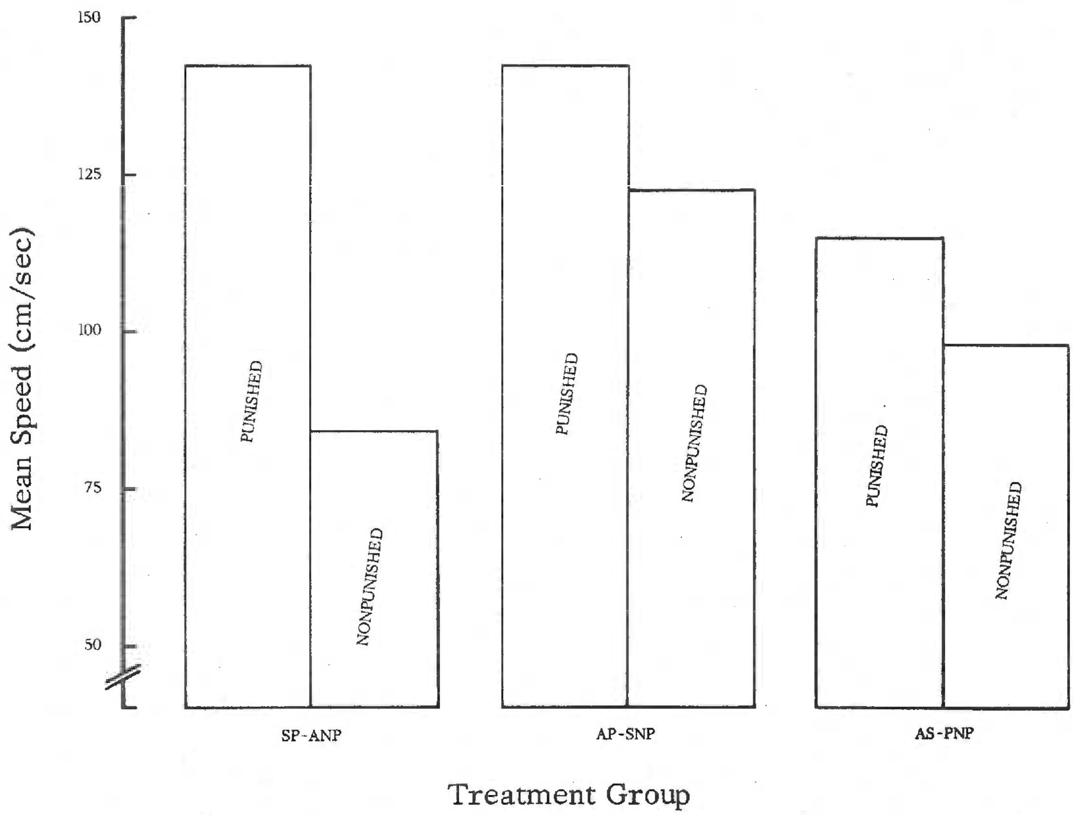

Figure 5. Running speeds in the middle segment, averaged across all extinction days. All mean speeds shown differed significantly except between SP-ANP and AP-SNP groups when trials for each were punished.

except that between punished SP-ANP and punished AP-SNP animals were significant.

Results in the final segment (Figure 6) consisted of a punishment effect [$F(1,12) = 42.56$, $p < .001$] and interactions of P with both T and D [$F(2,12) = 4.83$, $p < .05$ and $F(5,60) = 2.85$, $p < .05$, respectively]. Followup of the PT interaction with a Newman-Keuls test showed that the group speeds, averaged across days, were ordered as follows:

SP-ANP after punishment
AP-SNP after punishment

AP-SNP, nonpunished
AS-PNP after punishment

AS-PNP, nonpunished
SP-ANP, nonpunished.

Differences between groups paired in the above listing were not significant, whereas all other differences were. As can be seen in Figure 7, the interaction arose from the facts that AS-PNP animals ran more slowly on punished trials than their experimental counterparts, and that AP-SNP animals on nonpunished trials ran more swiftly than animals from the other two groups on nonpunished trials. The PD interaction, depicted in Figure 8, arose from the fact that on trials when the punishment contingency was in effect the animals did not decrease in speed over days, but did so on nonpunished trials (paired two-tailed $t = 2.47$, $p < .05$).

<u>Alcohol as a Signal</u>

In an effort to ascertain to what extent acquired signalling properties of alcohol and sugar water might have resulted in differential running in the initial segment (without any confounding from the shock-

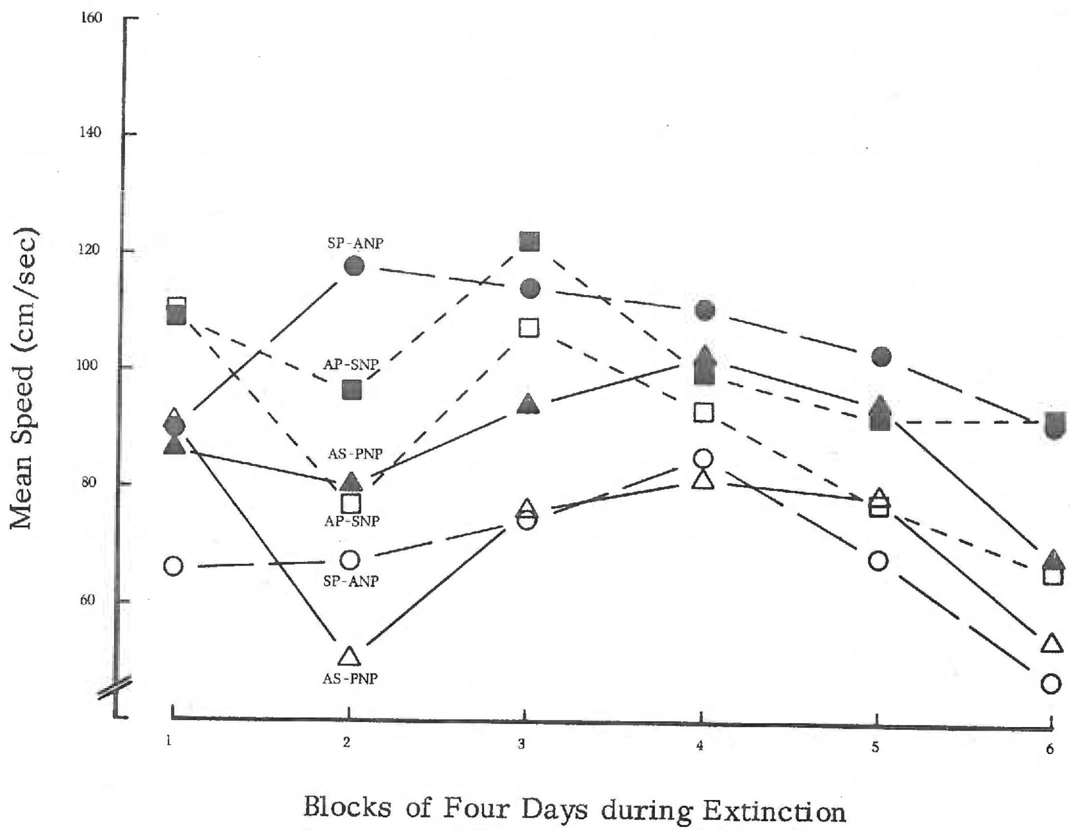

Figure 6. Final segment mean running speeds by treatment group and punishment contingency. Filled symbols denote trials on which shock-punishment was delivered in the middle segment; open symbols denote trials without shock-punishment.

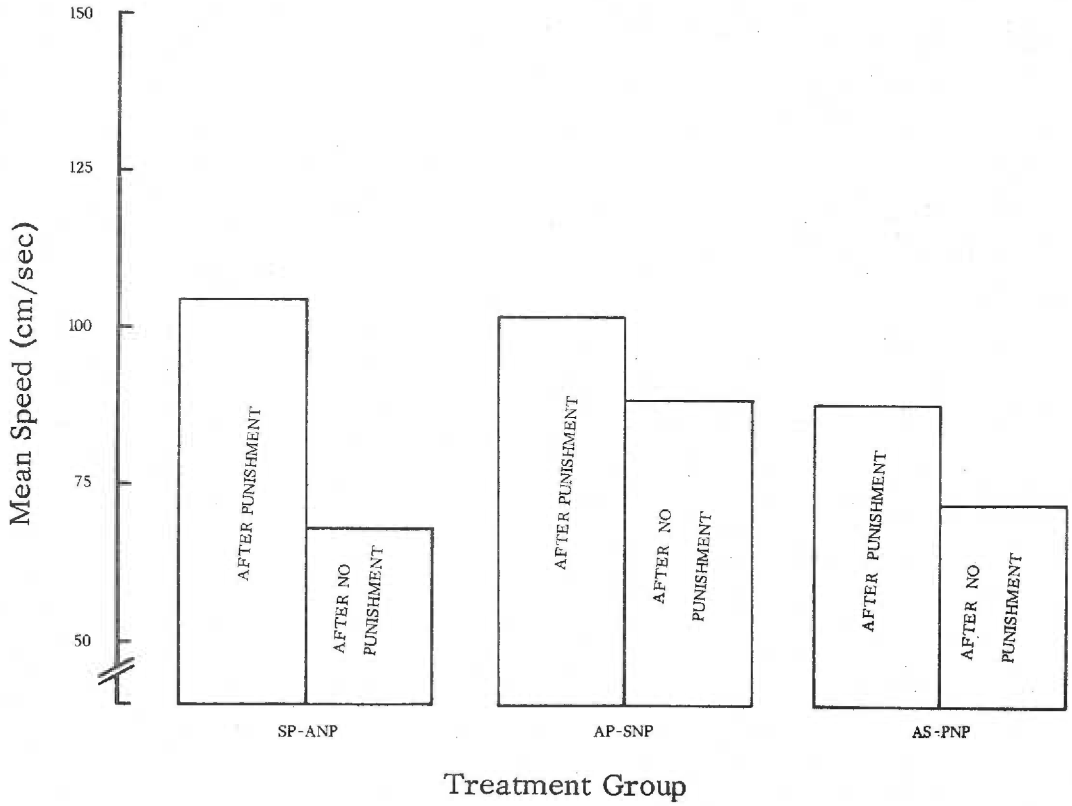

Figure 7. Average extinction phase running speeds for each treatment group in the final segment after punishment and no punishment in the middle segment.

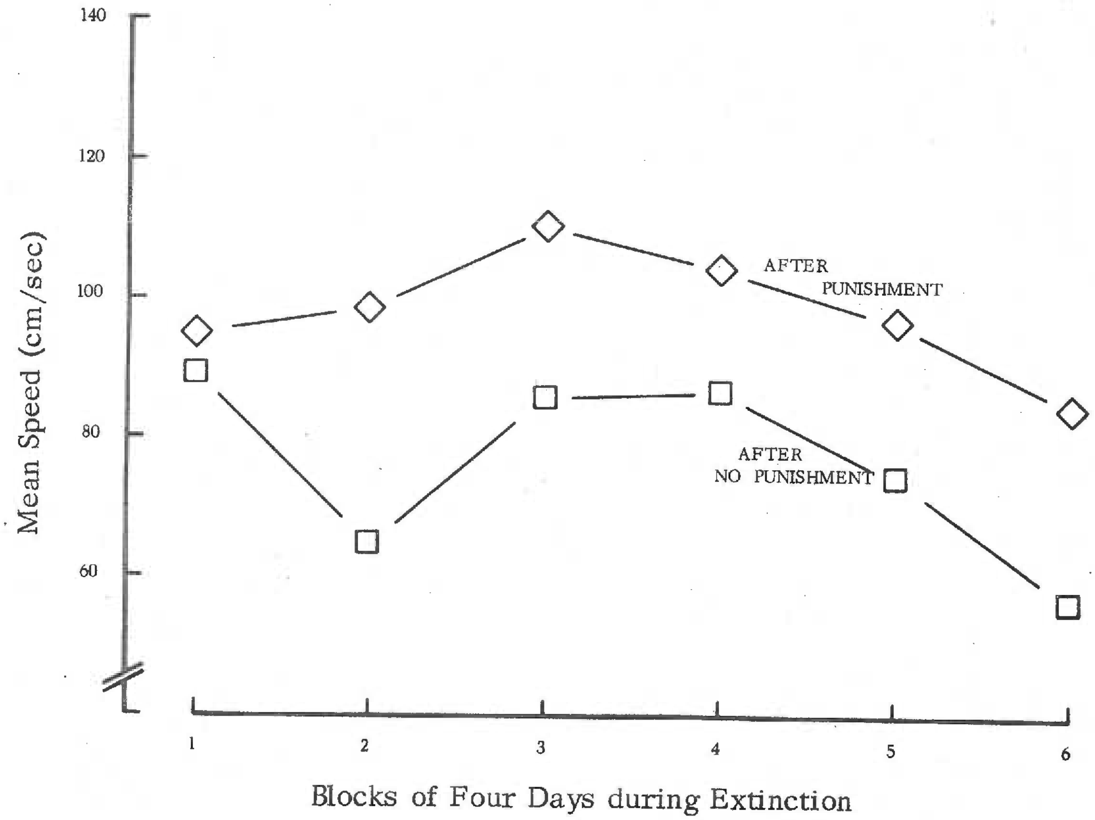

Figure 8. Effects of punishment in the middle segment upon running speeds through the final segment. Plotted points represent speeds averaged to include all three treatment groups.

punishment which might have affected speeds in the middle and final segments) in the absence of any residual emotionality which might have carried over from the shock of earlier trials to the second and third trial each day, running times for the first trial each day were extracted, converted to speeds, and subjected to analysis of variance. For this analysis the speeds were averaged over four-day blocks in accordance with the schedule for fluid alternation rather than for punishment contingency (as had been done in the other analyses of extinction data). For AP-SNP and SP-ANP animals the two procedures are equivalent, but for the AS-PNP animals the speed scores on ethanol and sugar water days were a mean of punished and nonpunished trials. In previous analyses, speed scores for AS-PNP group animals had been a mean of drugged and nondrugged trials under each punishment condition. When mean speeds through the initial segment on the first trial each day of extinction after alcohol and sugar water consumption were computed for each four-day block and subjected to a three-way analysis of variance (treatment group by solution by days), results consisted of significant main effects of solution [$F(1,12) = 21.23$, $p < .001$] and days [$F(5,60) = 4.02$, $p < .01$], no other main effect or interaction reaching significance. The solution effect can be visualized from Figure 9, where by collapsing across treatment groups one can see that alcohol resulted in generally slower locomotion. If the performance of the AS-PNP group is used as a baseline measure of the difference in running speed as a function of intoxication, it can be seen that punishing animals consistently when they are sober and not punishing them when drunk (SP-ANP curves) widens

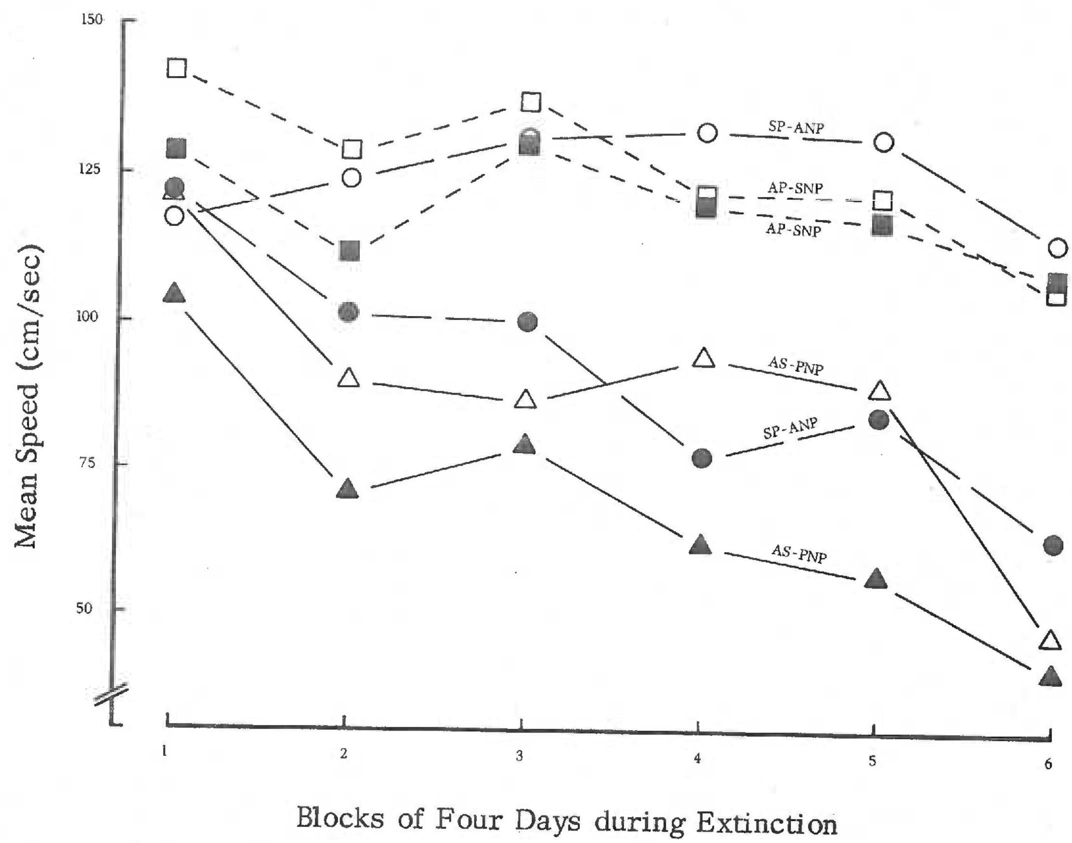

Figure 9. Running speeds in the initial segment on the first trial of each day during extinction, averaged in four day blocks. Filled symbols indicate speeds on days 4.75% ethanol was consumed; open symbols indicate speeds on days sugar water was consumed.

the separation between speeds, whereas administering the punishment consistently to inebriated subjects (AP-SNP) tends to pull running speeds together. The main effect of days consists of generally slower running speeds at the end of extinction than at the beginning.

Trials to Extinction

Up to 3% of the data used in the various analyses of variance consisted of estimated scores, most such scores being required because animals had met extinction criteria. If animals had stopped running earlier in one group than in the others, the influence of those estimated scores might have played a significant role in whatever effects were revealed by the analyses. The number of trials to extinction were monitored for each rat - differences between groups did not approach significance.

Weights, Fluid Consumption, and Dosage

The validity of conclusions about the treatment effects depends to some extent upon homogeneity of the groups with respect to other variables such as body weight, fluid consumption, and most importantly, alcohol dosage. Weight was monitored throughout the study, the first recording occurring just prior to initiation of the fluid deprivation schedule. Those weights are listed in Appendix A. There were no differences in the mean initial weights of the rats subsequently assigned to each group [$F(2,12) = .21$]. A mean weight was calculated for each rat over various phases of the experiment and a groups-by-phases analysis of variance was applied to these data. There was no groups effect or groups-by-phases interaction (Fs = 1.73 and 1.38, respectively), but there was a reliable overall increase in weight across the various phases [$F(5,60) = 237.25$]. As animals were eliminated from the running schedule because of their having met extinction criterion, weights were no longer recorded. Because of this missing information, data from Blocks 5 and 6 of extinction were analyzed separately, with only four rats in each group. Where data were still missing mean group weight was used. Such estimated scores comprised about 3% of the data. As with the analysis across phases, there was no groups effect or groups-by-days interaction but the main effect of days was significant [$F(1,9) = 5.91$, $p < .05$]. Figure 10 represents the weight changes throughout the experiment.

Fluid consumption was also monitored throughout the study. For pusposes of statistical analysis, data were grouped by exposure days, shock-escape training days, and extinction days. Data from exposure days and training days were averaged according to whether alcohol solution or sugar water solution was consumed, and two-way analyses were computed including factors of treatment group and type of solution. As shown in Figure 11, animals were found to consume significantly more sugar water than alcohol during both initial exposures to alcohol solutions [$F(1,12) = 21.85$, $p < .001$] and during shock-escape training [$F(1,12) = 11.92$, $p < .01$]. A three-way analysis of data during extinction revealed both a main effect of days [$F(5,60) = 6.66$, $p < .001$] and a main effect of solution [$F(1,12) = 43.81$, $p < .001$]. From Figure 11 it can be seen that although treatment group differences were not consistent, rats drank more sugar water than alcohol throughout extinction,

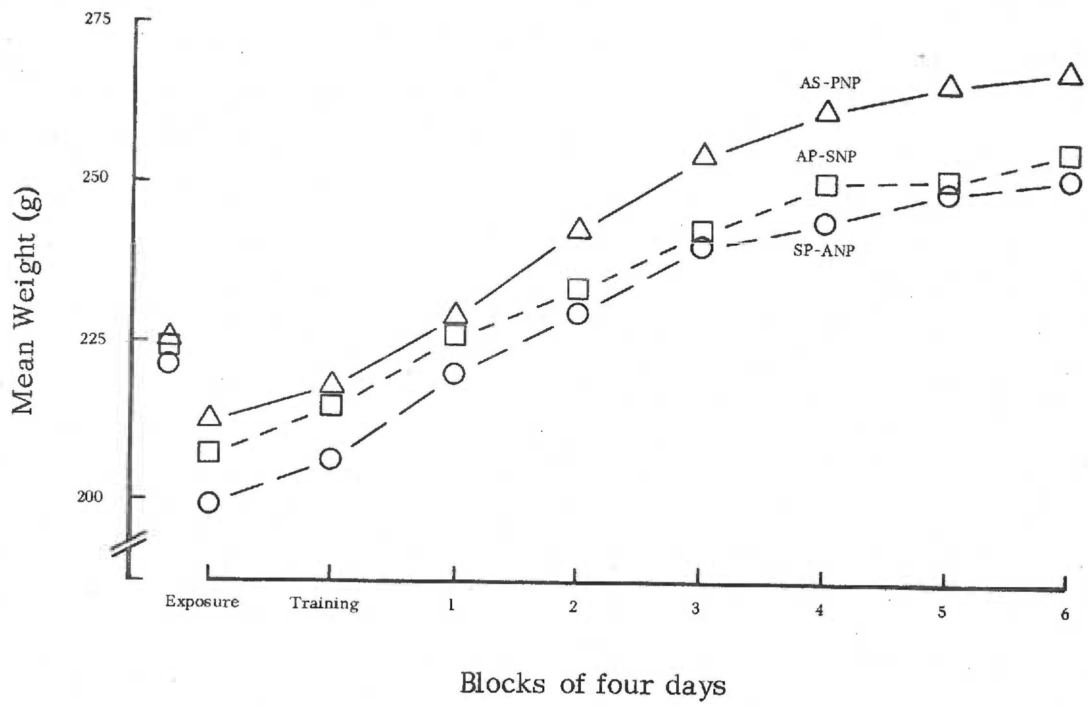

Figure 10. Changes in mean weight throughout the experiment. Isolated points at the left of the figure indicate initial weights, prior to initiation of the fluid deprivation schedule.

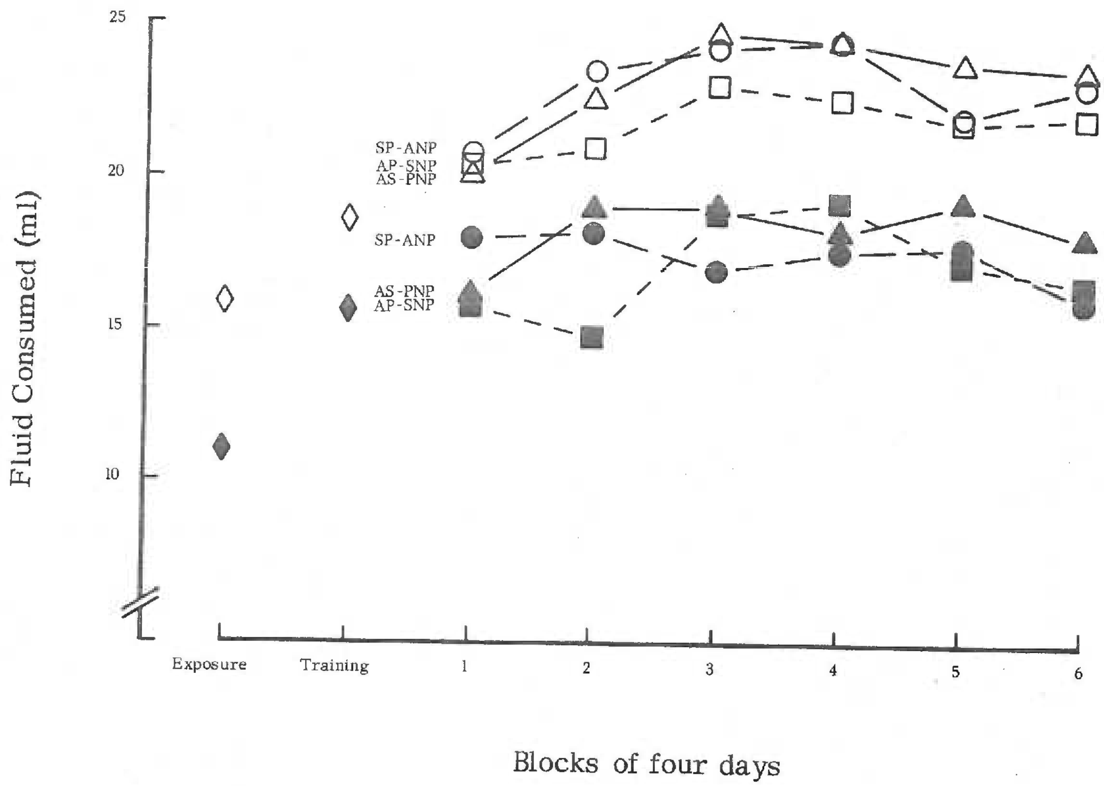

Figure 11. Mean fluid consumption throughout the experiment. Open symbols represent average amounts of sugar water drunk; solid symbols represent average amounts of 4.75% alcohol solution drunk. Isolated points at the left indicate consumption for all animals (group assignments were not effective until the extinction phase began).

and in addition increased their consumption of both solutions from the beginning to the end of extinction.

Using weights and amounts of alcohol solution consumed, dosages were computed for each animal on each day alcohol was administered, and were averaged over four-day blocks (on two days of each four day block alcohol was consumed). These mean dosages, shown in Figure 12, were subjected to a two-way analysis of variance by treatment group (T) and days (D). The D effect was highly significant [$F(7,84) = 7.25$, $p < .001$) but neither T nor the TD interaction was significant (both Fs < 1). Followup tests showed only the change in dosage from exposure days to training days to be significant (paired two-tailed $t = 4.4$, df = 14, $p < .01$). Thereafter neither the change in dosage from training to Block 1 of extinction nor the change from Block 1 to Block 6 of extinction was significant (all tests collapsed across treatment group conditions).

Discussion

In the typical self-punitive study a nonpunished group is run, against which one can measure the effects of response-contingent shock. When a within-subjects design is used, however, all subjects receive shock-punishment on some trials and the measure of self-punitive behavior becomes one of running speeds on punished trials versus running speeds on nonpunished trials. By that measure in the present study only one group of animals showed self-punitive behavior in the initial segment: the SP-ANP animals. For the other two groups, punished speeds did not differ significantly from nonpunished speeds. In the middle

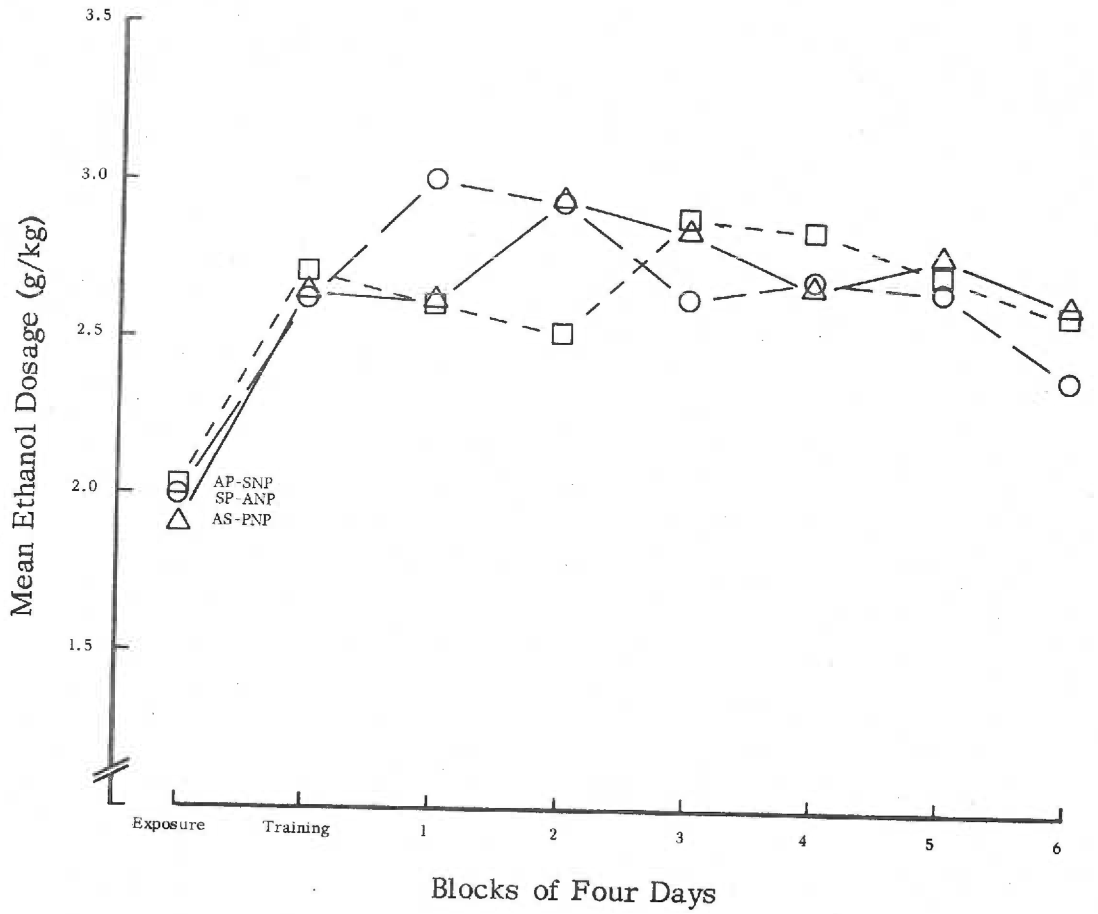

Figure 12. Alcohol dosage during exposure, training, and extinction.

segment, presumably because of the immediate dynamogenic effects of shock, animals in all three groups ran more swiftly when punished than when not punished. A similar result in the final segment may be owing to after-effects of the shock in the middle segment.

In addition, even though for all animals 50% of the trials during extinction were punished, animals for which one or the other drug condition was consistently paired with shock punishment ran more swiftly on punished trials than their AS-PNP group counterparts in each of the alley segments. Apparently the addition of a consistently predictive cue (drug state) was sufficient to generate more rapid running than was elicited in the absence of that cue. In this respect, the results of the present study agree with those of previous studies (Brown, 1970; Brown et al., 1971; Crowell et al., 1972) and support the notion that stimuli that are perfectly correlated with impending shock may enhance self-punitive running (Brown, 1970).

Running on nonpunished trials was not affected in the same way by the consistent pairing of drug state cues as running on punished trials. If the performance of the AS-PNP animals is used as a baseline against which to measure the effects of pairing alcohol or sugar water consumption with either punishment or no punishment, one first sees that impending punishment makes no difference for AS-PNP animals in the initial segment (Figure 3). That is, the animals run at approximately the same rate whether the response is to be punished or not. This is to be expected since neither alcohol nor sugar water has been uniquely associated with punishment or no punishment. However, AP-SNP rats also run at approximately the same rate whether the response is to be punished or not, but their speeds are significantly faster than those of AS-PNP rats. Somehow the consistent pairing of alcohol with punishment (AP-SNP rats) elevates performance on both punished and nonpunished trials. This elevation of speeds on nonpunished trials was not the case for SP-ANP rats.

In general, then, the results of Experiment 1 as reflected by running speeds may be summarized as follows: (a) only when alcohol consumption was paired with the absence of punishment (and sugar water consumption with punishment) was the self-punitive effect obtained in the initial segment (SP-ANP animals in a within-group comparison), (b) consistent pairing of alcohol or sugar water consumption with shock-punishment resulted in faster running in all segments than when drug state cues did not reliably signal the presence of shock-punishment (on punished trials SP-ANP and AP-SNP rats ran faster in all segments than their AS-PNP group counterparts), and (c) only when intoxication signalled punishment (and sobriety nonpunishment) did animals run faster on nonpunished trials than animals for whom drug state was not a reliable signal (on nonpunished trials AP-SNP animals ran faster than their AS-PNP counterparts in all alley segments). An explanation for these results is outlined in the discussion section of Experiment 2, following.

When one attempts to compare drug states to external stimuli, problems arise because of confounding consequences accompanying some modes of drug administration. Thus, for example, Freed (1968) has suggested that intraperitoneal injections have stressful attributes that summate with other stressors such as shock. In addition, the writer has observed that animals become increasingly difficult to handle as a schedule of repeated intraperitoneal injections of alcohol continues. Because of the effects of relatively traumatic modes of alcohol administration (which may increase in magnitude over the course of an experiment), a mode of administration which produces a minimum of such effects was selected for this study. Thus animals were placed on a fluid deprivation schedule prior to the experiment, and an alcohol solution was substituted for sugar water on days when the experimental design required the rat to be intoxicated. This procedure resulted in doses that averaged 2.7 g/kg (range = 1.7 to 3.6 g/kg), and which did not change significantly after the initial exposure days. These data are in general agreement with those reported by Eckardt (1974). He found consumption by rats of a 5% ethyl alcohol solution to result in doses averaging 2.4 g/kg, those doses remaining relatively stable after a period of fluctuation during the first 5 days of exposure to alcohol. In the present experiment, dosage varied somewhat from day to day and from subject to subject, but did not change significantly either as a function of days or group assignment. The dosage was high enough to produce noticable impairment of locomotion during shock-escape training, and, at least nominally, compares favorably with doses found in the animal literature. Of course, such a comparison is of limited value since the behavioral effects of ethanol administration vary considerably depending upon means of intake, the contents of the gastro-intestinal tract, the concentration of the drug solution, etc. One potential drawback of this self-administration method is the finding that animals drank more fluid on days when no alcohol was in the solution (see Figure 11). Thus the effects observed are possibly attributable to differences in total body weight, stomach distension, level of thirst, or other factors resulting from the differences in fluid consumption which were confounded with the presence of alcohol. Reference to Figure 9 will be helpful in negating this possibility. If thirst or stomach distension had increased drive level for animals which drank less fluid (filled symbols for each group), then speeds would presumably be faster on those days. Instead, speeds were slower on days of alcohol consumption. Similarly, if increased body weight had slowed running on days the animals drank more fluid (open symbols for each group), then speeds would presumably be slower after sugar water consumption. But that was not the case. So the results were not consistent in any straightforward sense with hypotheses generated from notions about effects of differential fluid consumption. The finding that oral self-administration of alcohol by rats results in practicable doses indicates this is a viable alternative to repeated traumatic intubation and injection techniques in situations where exact dosing is not required.

EXPERIMENT 2

A second replication was planned in order to increase group sizes. Twenty-one additional animals were obtained and subjected to procedures identical with those of the first replication. Confusion about procedures for preparing the alcohol solution resulted in a 3.17% solution's being offered on the last two days of exposure to alcohol and the first two days of shock-escape training. Discovery of this change in procedure led to a decision to continue these subjects on a 3.17% schedule, justification for which follows. As noted previously, a potential problem with the first study was the fact that animals drank more on days when no alcohol was in the solution. Thus the effects observed were conceivably attributable to differences in total body weight, stomach distension, level of thirst, or other factors resulting from the differences in fluid consumption which were confounded with the presence of alcohol. Even though results were not consistent in any straightforward sense with hypotheses generated from notions about effects of differential fluid consumption, the possibility of equating fluid intake seemed worth pursuing. Lowered concentration of the alcohol solution would likely result in an increase in consumption, making intake more comparable between days when no alcohol was present and when the 3.17% solution was used. In addition, the consistent dosing across days of the first replication may have been peculiar to the ethanol concentration. Use of a different concentration would produce information about the generality of those findings. Finally, the stimulus-like effects of drugs are dose dependent (Thompson & Pickens, 1971). If lower doses than those of the first study were to result from use of a 3.17% solution, then differences in drug effects observed in the two experiments might offer some clues as to the appropriate explanation for the experimental results.

Method

Subjects

The subjects were 21 naive female albino rats (Sprague-Dawley derivatives from Carworth Farms, Inc., Portage, Michigan), 60 days of age upon arrival in the laboratory. They were housed under constant temperature conditions (24^{o} C) and a 12 h day-night cycle, four or five animals per large cage for 32 days, with water and laboratory chow available ad lib. On the 33d day the animals were moved to individual cages and randomly assigned to one of the treatment conditions. Thereafter they were maintained on a fluid deprivation schedule which allowed 10 min access to fluid each 24 h, with laboratory chow available ad lib.

Apparatus

The apparatus used in Experiment 1 was again used here, without modification.

Procedure

The procedure was identical to that of Experiment 1, save for differences in ethanol concentration. On their first exposure to alcohol, subjects were offered the same 4.75% solution as in Experiment 1. Thereafter the alcohol solution was comprised of 60 g of granulated cane sugar, 25 ml of 95% ethyl alcohol, and room temperature tap water to a volume of 750 ml (a 3.17% v/v solution). The within-subjects design called for shock-escape training under both drugged and nondrugged conditions, followed by an extinction phase during which days of alcohol consumption involved shock-punishment for one group (AP-SNP) and days of sugar water consumption involved shock-punishment for another group (SP-ANP); days on which the alternate solution was drunk being days of nonpunished trials. For a third group (AS-PNP) days of alcohol consumption and days of sugar water consumption were shock-punishment days half the time, nonpunished trials being administered the other half of the time.

Results

Shock-Escape Acquisition Data

Daily three-trial median running times were determined for each rat for the starting segment and for each of the three alley segments. Data were then grouped in accordance with the ABBA schedule for administering drinking solutions, and mean scores were computed for each animal under conditions of alcohol and no alcohol. Thus two scores were available for each rat in each alley segment: mean running speed after alcohol consumption and mean running speed after sugar water consumption. These speeds served as the basic data in the analyses of variance of performances during acquisition.

Mean speeds in each of the segments under conditions of alcohol and sugar water are tabulated in Appendix B. In all segments, neither drug condition nor treatment group contributed significantly to the variance, nor was the interaction of those two factors significant.

Extinction Data

Daily median running times were manipulated as in Experiment 1 and subjected to analyses of variance. Illustrative figures comprise Appendix C.

Starting segment speeds. An overall analysis of speeds in the starting section yielded a significant main effect of days [$F(5,90) = 3.15$, $p < .05$] and a significant interaction between punishment and treatment factors [$F(2,18) = 6.74$, $p < .01$]. The days effect reflects a general trend toward slower running as the extinction phase progressed. The interaction is portrayed in Figure 13, where it can be seen that the SP-ANP animals on nonpunished trials and the AP-SNP animals on punished trials ran more slowly than any others; in addition running speeds of SP-ANP animals before punishment and of AS-PNP subjects on nonpunished trials differed significantly (all ps $< .05$).

Alley segment speeds. Separate overall analyses were made of the speed data from each of the three alley segments. Of the three main effects, namely: treatment group (T), punishment (P), and days (D), the second and third were significant in all three segments (all ps $< .001$ except for the initial segment P effect where $p < .05$). The T effect never approached significance (all Fs < 1) but did interact with the punishment effect in all three segments [initial: $F(2,18) = 5.73$, middle: $F(2,18) = 4.49$, final: $F(2,18) = 5.97$, all ps $< .05$]. Those interactions are illustrated in Figures 14, 15, and 16. In the initial segment (Figure 14), SP-ANP subjects before punishment and AP-SNP rats on trials before punishment and on trials without punishment did not

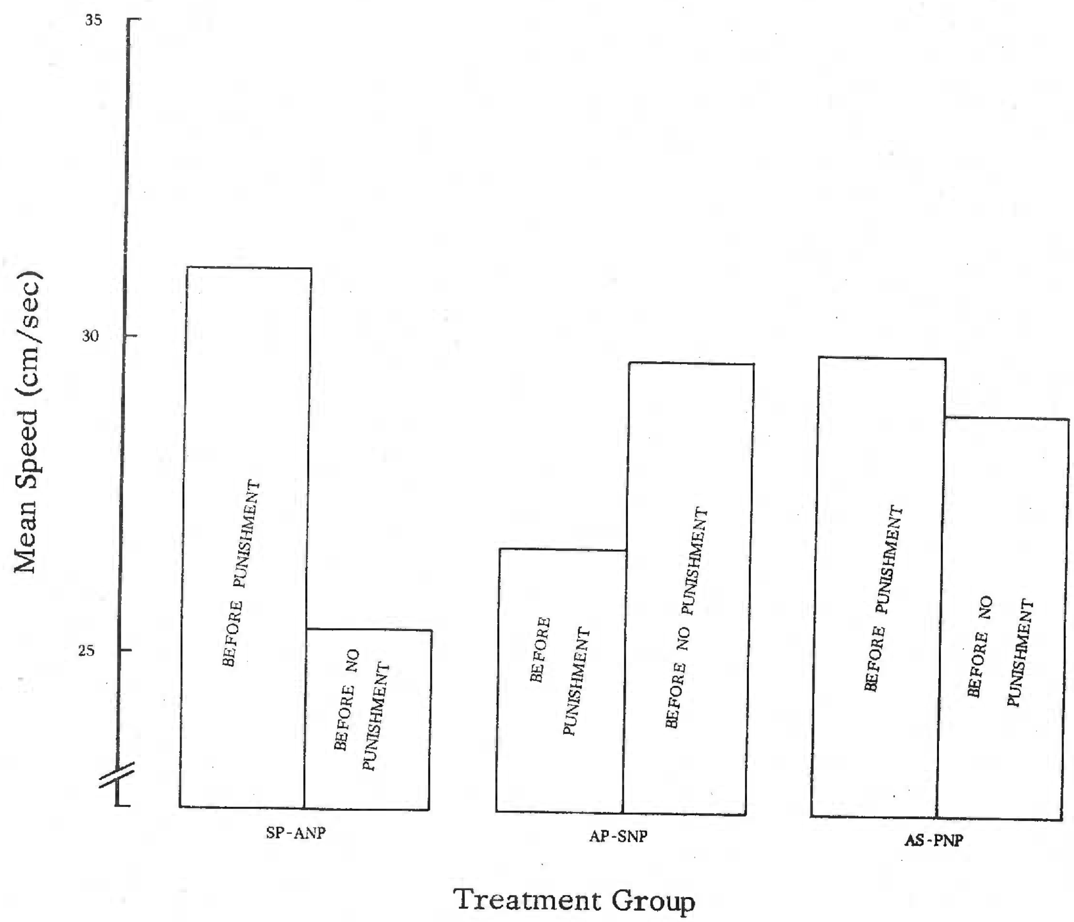

Figure 13. The speed of rats in the starting segment averaged across all extinction days.

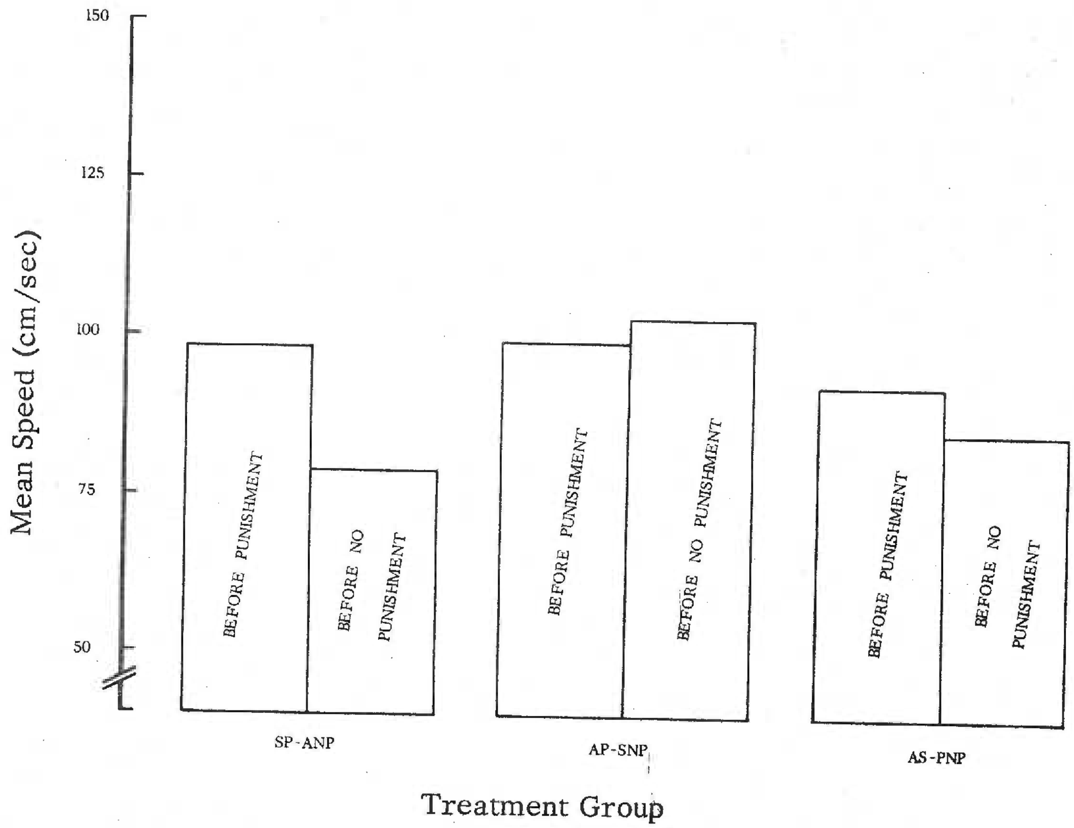

Figure 14. Running speeds through the initial segment averaged over all extinction days.

differ from each other but did differ from nonpunished SP-ANPs and AS-PNPs on trials before punishment and on trials without punishment. In addition, speeds on nonpunished trials for SP-ANPs and on both punished and nonpunished trials for AS-PNPs differed significantly (all $\underline{p}$s $< .05$).

In the middle segment (Figure 15) the speeds on punished trials for SP-ANPs and AP-SNPs were similar and faster than all other groups, all other groups differing between themselves both on punished and nonpunished trials.

Figure 16 shows final segment speeds, which for SP-ANP animals following punishment were faster than all others. Punished AS-PNPs and AP-SNPs punished and nonpunished did not differ significantly between themselves, but did run faster than nonpunished AS-PNPs and SP-ANPs. Nonpunished AS-PNPs were faster than nonpunished SP-ANPs. All followup evaluations were done with Newman-Keuls tests. In addition to the significant days effect in all segments, days interacted with punishment in the middle and final segments. Those interactions are displayed in Figures 17 and 18.

Alcohol as a Signal

As in Experiment 1, an attempt was made to ascertain to what extent the drug state became a response-eliciting or response-enhancing signal, unconfounded by immediate effects of shock or longer-lasting emotional effects subsequent to shock. Factors of drug [$\underline{F}(1,18) = 11.8$, $\underline{p} < .01$] and days [$\underline{F}(5,90) = 8.85$, $\underline{p} < .001$] were significant. No other main effect or interaction approached significance. The drug effect and days effect are depicted in Figure 19, where one notices that animals slacken

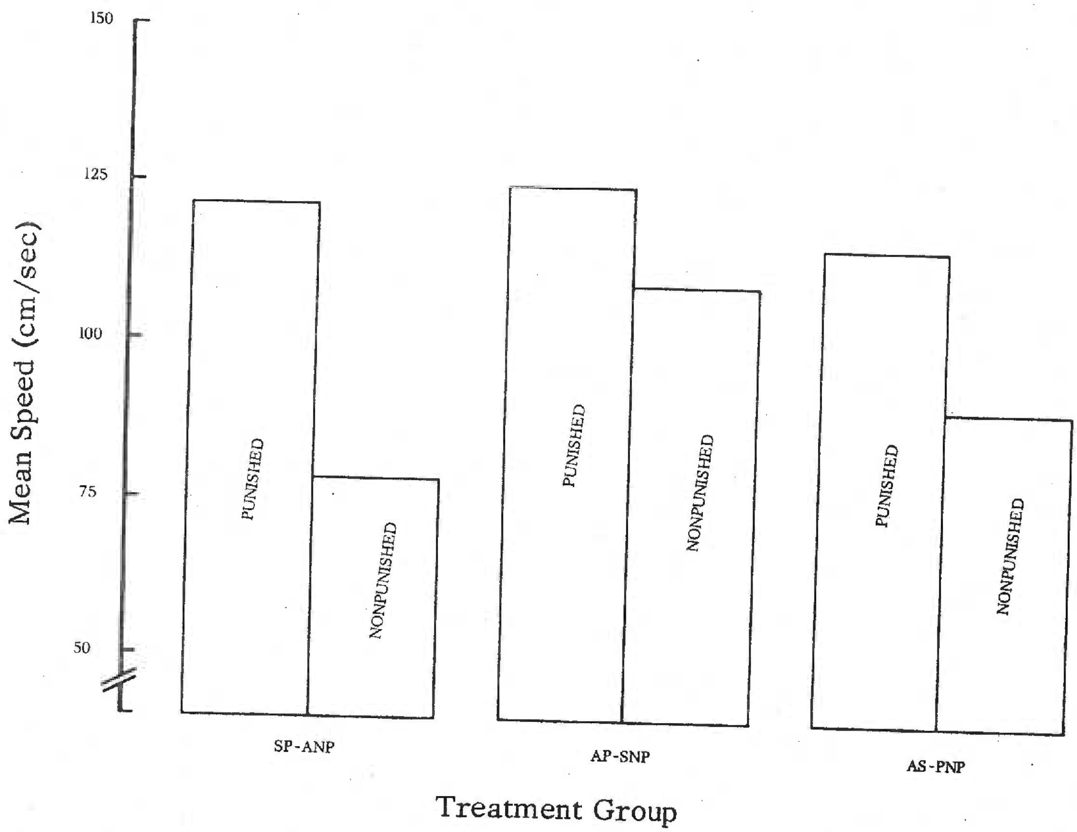

Figure 15. Speed scores in the middle segment collapsed across extinction days. On punished trials rats were shocked in this segment.

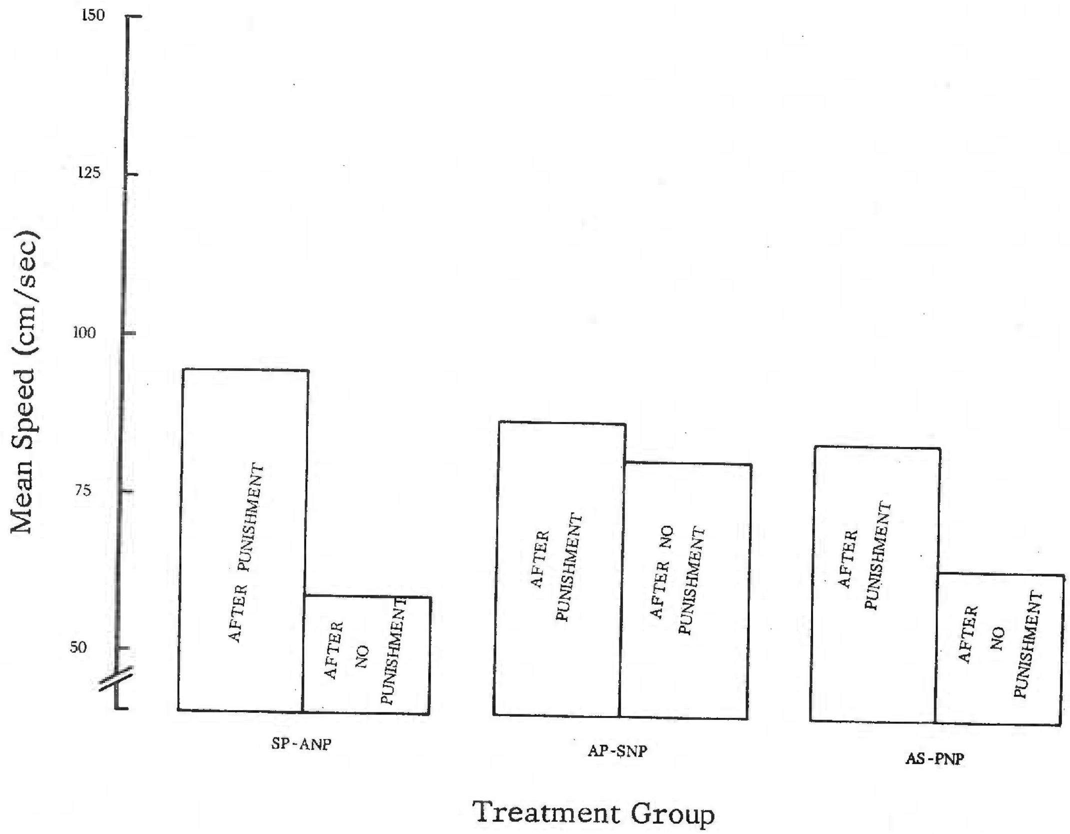

Figure 16. Mean running speeds through the final segment, averaged across all extinction days.

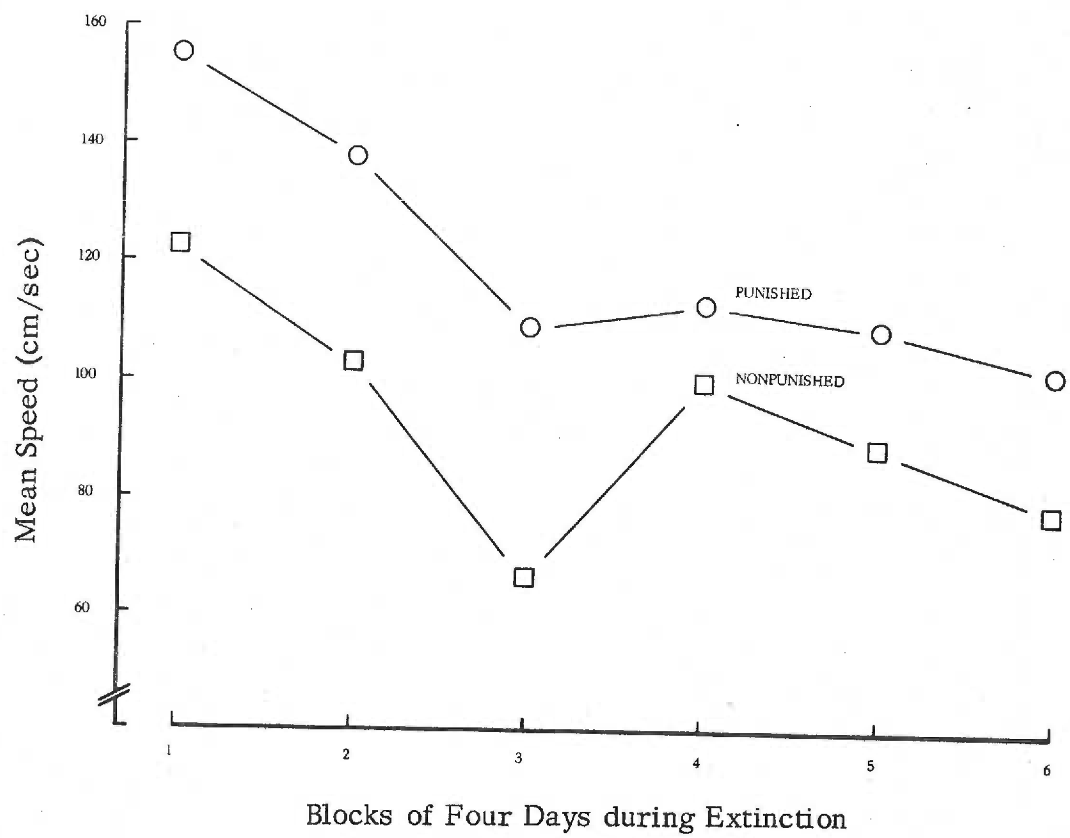

Figure 17. Effects of punishment on locomotion through the middle segment during extinction. Speed scores are composite averages for all three experimental groups.

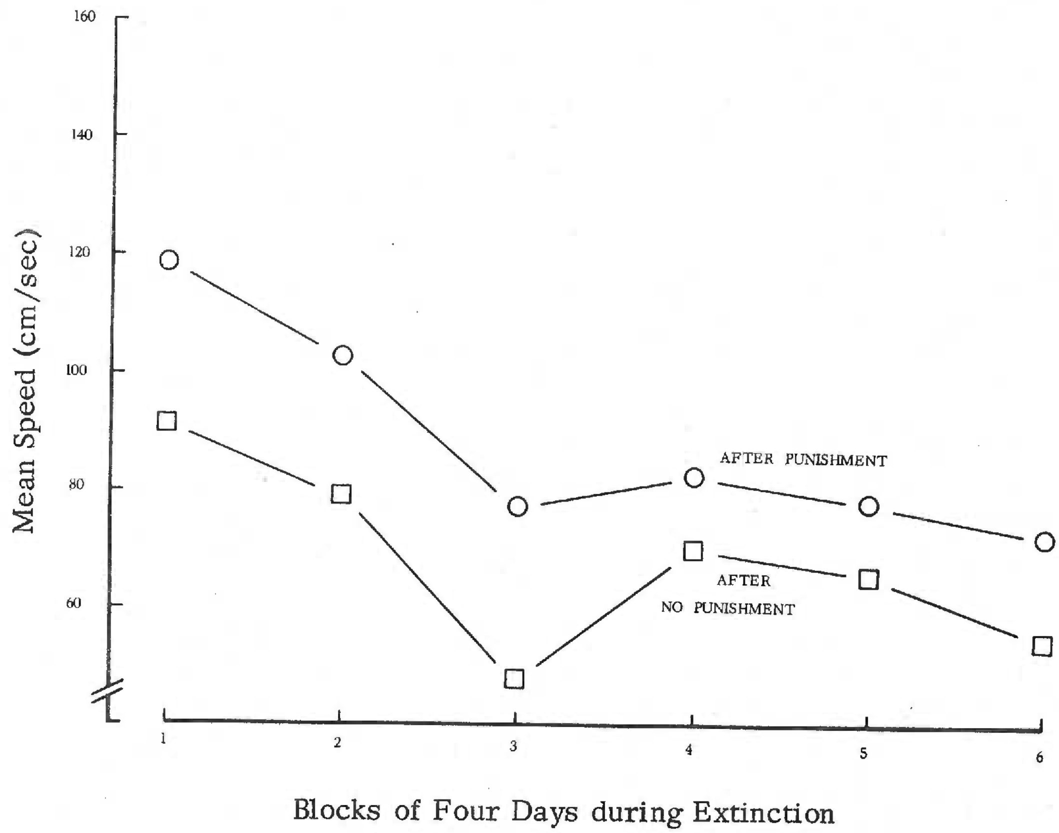

Figure 18. Running speeds through the final segment, collapsed across treatment group.

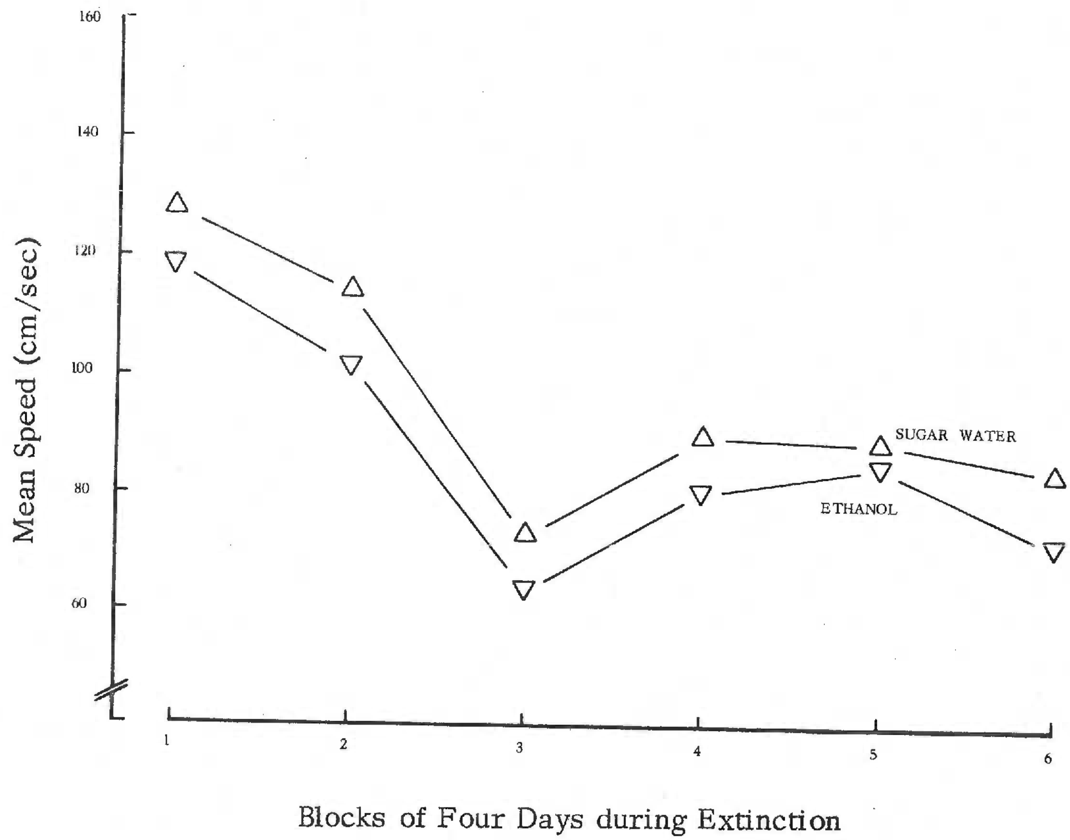

Figure 19. The influence of alcohol and progression through the extinction phase on running speeds in the initial segment. Means of the first trial each day are plotted as a function of blocks of extinction days. Concentration of the alcohol solution was 3.17%.

speed slightly when drugged, and slacken speed conspicuously by the end of extinction regardless of drug condition.

Trials to Extinction

As in Experiment 1, trials to extinction criterion were monitored for each subject. What differences there were between groups did not approach significance (see Appendix B).

Weights, Fluid Consumption, and Dosage

A one-way analysis of variance of weights (results tabulated in Appendix B) revealed no differences between groups in initial weight (F = 1.1). Weights increased significantly over the phases of the experiment [$F(3,54) = 107.04$, $p < .001$], including Blocks 3 and 4 [$F(1,12) = 19.69$, $p < .001$] and 5 and 6 of extinction [$F(1,9) = 4.41$, $p < .05$]. As in Experiment 1, data were analyzed in blocks of 4 days, and fewer subjects were included in the analyses of weights during final extinction days because of subjects' meeting extinction criterion. Figure 20 represents the weight changes from the beginning of the experiment to the end of extinction.

Fluid consumption data were grouped by exposure days, shock-escape training days, and extinction days, and separate analyses were conducted. Data from exposure days and training days were averaged according to whether alcohol solution or sugar water was consumed, and two-way analyses were computed including factors of treatment group and type of solution. As shown in Figure 21, animals were found to consume significantly more sugar water than alcohol solution only during initial exposure days [$F(1,18) = 113.74$, $p < .001$]. Analyses of variance of data during

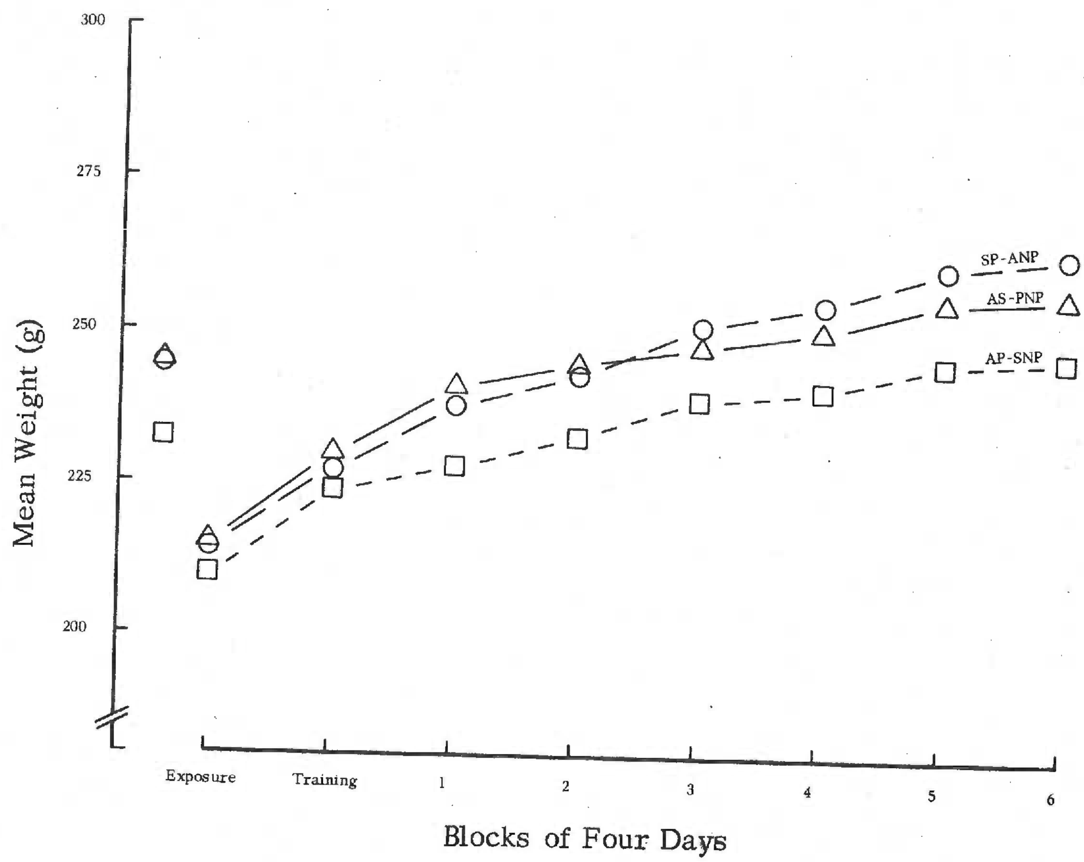

Figure 20. Mean weights, by treatment group, throughout the experiment. Isolated points at the left indicate initial weights, prior to initiation of the fluid deprivation schedule. Weights increased significantly from Exposure through Block 6, but differences between groups were not significant.

extinction included factors of treatment group, solution type, and days (three-way analyses, repeated measures on two factors). For these analyses, data were paired in four-day blocks with successively fewer subjects in each pair of blocks as extinction criterion was met. Only the days effect was significant, and only across the first two blocks of four days [$F(1,18) = 17.86$, $p < .001$]. This can be seen in Figure 21, where after an increase from the first block of days to the second, fluid consumption stays at about the same level for both solutions for all groups.

Dosages were computed for each animal on each day alcohol was administered, and averaged within four-day blocks (on two days of each four-day block alcohol was consumed). These mean dosages, shown in Figure 22, were subjected to a two-way analysis of variance with factors of treatment group (T) and days (D). The D effect was highly significant [$F(3,54) = 70.75$, $p < .001$] but neither T nor the TD interaction was significant. As can be seen in Figure 22, following a sharp rise in dose from exposure days to training days, doses thereafter were clustered around 2.5 g/kg. As with weight and fluid consumption data, fewer subjects were included in the two-way analyses for the final four blocks of extinction days. Neither of the main effects nor their interaction was significant during the final blocks of extinction (see Appendix B).

Discussion

The results of the second experiment were similar to those of the first. While the differences in running speed under the various experimental conditions were less dramatic with the lower alcohol concentration

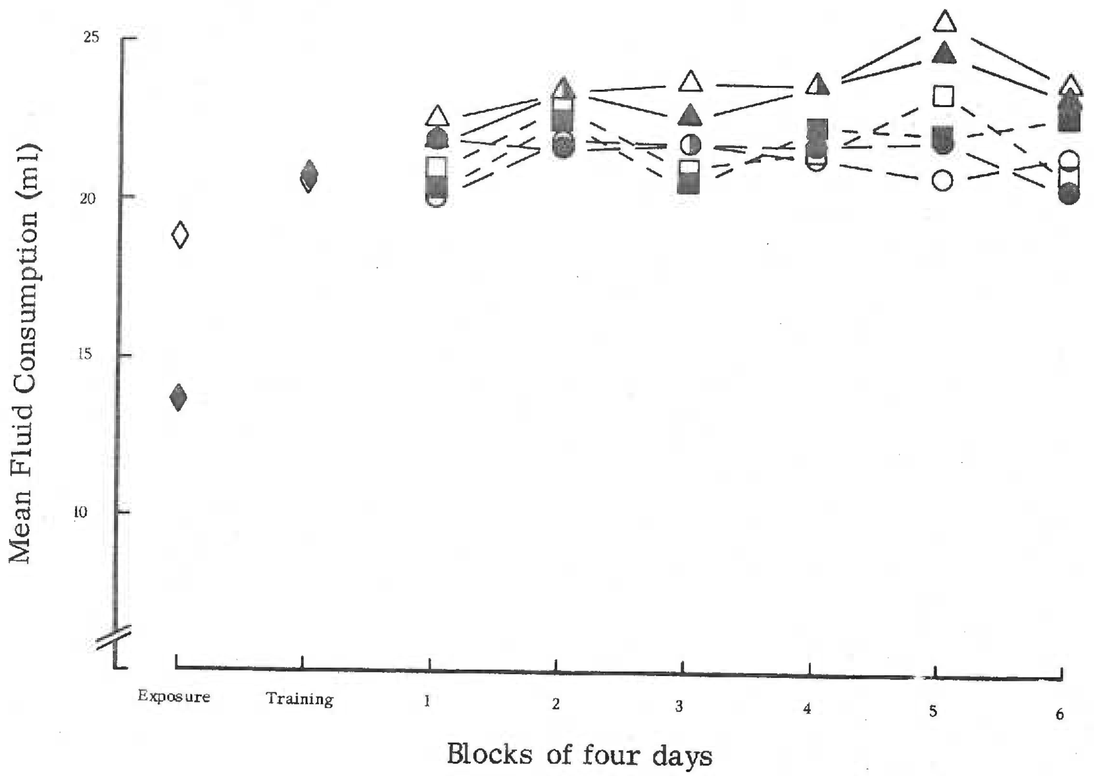

Figure 21. Amounts of sugar water and 3.17% alcohol solution consumed throughout the experiment. Filled symbols indicate alcohol solution; open symbols indicate sugar water. △ = AS-PNP, □ = AP-SNP, ○ = SP-ANP.

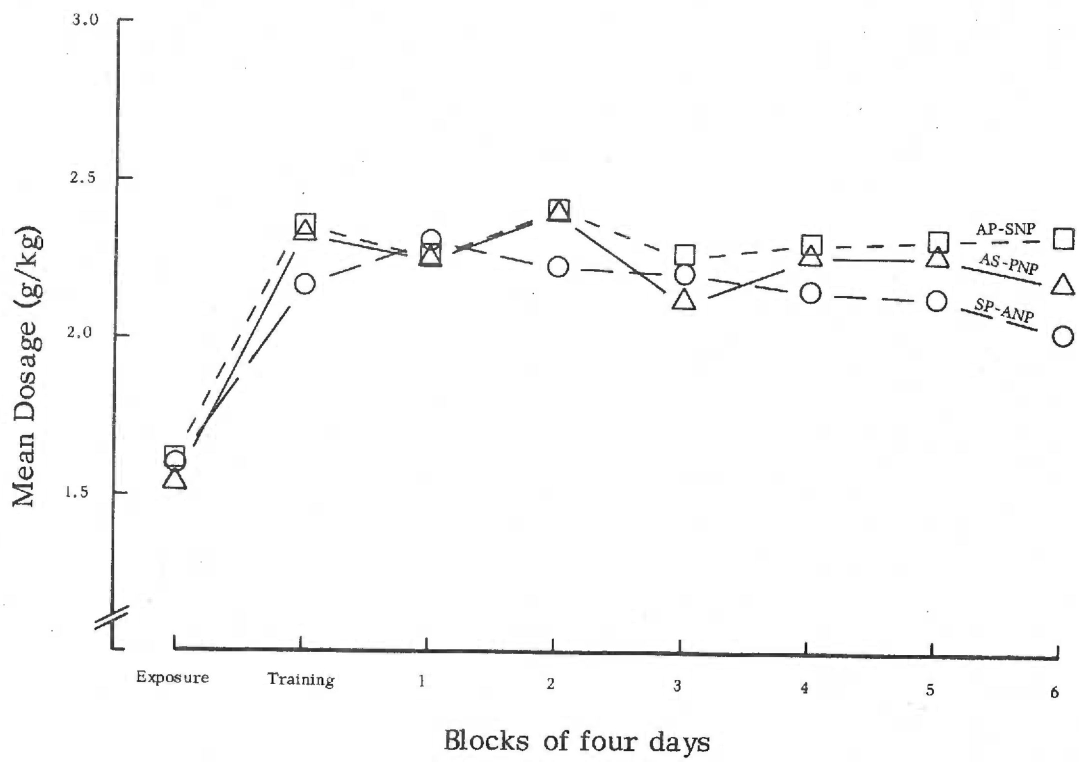

Figure 22. Mean alcohol dosage, by treatment group, throughout the experiment.

(as comparison of Figures 3, 4, and 6 with Figures C1, C2, and C3 will vividly illustrate), those differences were nonetheless statistically significant and obvious when graphed appropriately (Figures 14, 15, and 16). Use of the lower concentration of alcohol resulted in slightly lower average doses (2.2 vs. 2.7 g/kg) which again, while varying somewhat from day to day and from subject to subject, did not change significantly either as a function of days or group assignment.

Theoretically, perhaps the most challenging aspect of the results is the apparent asymmetry mentioned in the earlier discussion. Examination of Figures 2 and 13 will reveal the asymmetry clearly. For SP-ANP animals, speeds in the starting section on trials when shock was pending in the middle segment were higher than speeds when no shock was to be encountered in the middle segment. The reverse was true for AP-SNP rats: speeds prior to punishment were lower than speeds prior to no punishment. Possibly the most parsimonious explanation involves two well-documented effects of alcohol: (a) a motor effect which results in slowed running, and (b) a cue effect which results in stimulus control. One might assume that the motor effect will always (except, perhaps, at very small doses) interfere with locomotion, while the cue effect will change behavior as a function of acquired secondary properties. In other words, if the cues accompanying intoxication are consistently paired with a response (e.g. fear or running), alcohol cues will come to elicit that response. But if the same cues are paired with inhibition of responding, then they will come to inhibit responding. If one assumes that the placebo (sugar water) of the present experiments produces neither of these effects, the experiments can be described as follows. For one group (SP-ANP), on punished trials there was no signal other than alley cues and running was unimpeded (no motor effect of alcohol), while on nonpunished trials a signal was present which, over the course of extinction trials, presumably acquired secondary inhibitory properties, that inhibition of running adding to the motor deficit produced by alcohol throughout extinction. For another group (AP-SNP), a signal was present on punished trials which elicited fear as a result of its pairing with shock both during training and extinction. The fear elicited by alcohol cues operated concurrently with the fear elicited by alley cues and with the motor deficit. On nonpunished trials for the AP-SNP group no signal other than alley cues was present and no motor deficit was operating. For a third group (AS-PNP), a signal was present and running was slowed on half the punished and nonpunished trials while no signal was present and running was unaffected by motor impairment on half the punished and nonpunished trials. For this group the cue properties of alcohol presumably had little or no impact, since they were paired both with shock-punishment and no shock-punishment. Given the above analysis of the effects of alcohol in the present experiments, what predictions follow?

If discussion is limited to speeds through the starting and initial segments, prior to the punishment zone, then the fear aroused by the cues present when the rats are in those segments should be the primary determinant of performance, motivating running from those segments through the alley. Early in extinction the fear elicited by the cues present in the starting and initial segments should be determined primarily by the fear conditioning which occurred during shock-escape training. For the SP-ANP group, then, early in extinction speeds should be slower on nonpunished trials because of the motor deficit produced by alcohol. After a number of extinction trials, speeds should begin to diverge even more because the cue properties of alcohol become conditioned inhibitors of running as a result of their pairing with the inhibition of responding which is generated on nonpunished extinction trials. On punished trials the alley cues continue to elicit fear which motivates running. The fear is reinforced by shock-punishment and the running is reinforced by shock offset and by the offset of the alley cues when the rat enters the goalbox. Note that this perseverative running will occur even if the sugar water is inadequate as a cue and thus does not signal impending shock. Reference to Figure 3 will show that SP-ANP rats ran in accordance with these predictions.

Animals of the AP-SNP group, on the other hand, encounter punishment when the alcohol signal is present. Early in extinction, running speeds should be slower on punished than on nonpunished trials because of the motor deficit produced by alcohol. However, as the cue properties of alcohol come to signal impending punishment and the usual processes of regular extinction begin to affect running on sugar water-nonpunished trials, speeds on the two types of trial should converge, after which speeds on nonpunished trials should drop below those of punished trials. Whether there will be a difference in speeds on punished trials for AP-SNP and SP-ANP animals is difficult to predict.

The two sources of fear for AP-SNP animals (alley cues and alcohol cues) might produce faster running than is the case for SP-ANP animals, but alcohol also interferes with running because of the motor effect. Figure 3 shows that speeds of AP-SNP rats on punished trials were generally slower, though not significantly so, than those of SP-ANP rats on punished trials.

As has been stated, presumably the cue effects of alcohol have little or no impact on running speeds for AS-PNP animals, since half the time they signal punishment and half the time no punishment. But speeds on the alcohol half of punished and nonpunished trials should be slowed by the motor deficit, as reference to Figure 9 shows. Speeds for these animals, then, should be below those of AP-SNP animals on both types of trials and below those of SP-ANP animals on punished trials (see Figure 3). A logical question arising in reaction to the above analysis is "why do the alley cues not come to inhibit running for AP-SNP rats as the alcohol cues do for SP-ANP rats?" Overton's (1971) suggestion that centrally acting drugs are more effective in acquiring response control in discrimination paradigms than are external stimuli may answer the question, indicating that the present data can be construed as supporting Overton's assertion.

Results of the present experiments which are not predicted by the above analysis include the initial segment speeds on Block 1 of extinction for AP-SNP animals in Experiment 1. On trials when those animals drank sugar water and no shock was in the middle segment, speeds through the initial segment were faster than those of any other group, punished or nonpunished (see Figure 3). In addition, alcohol-produced motor impairment might have slowed speeds for those animals through the middle segment on punished trials, but did not (see Figure 5), possibly because of the potent dynamogenic effects of shock present in that segment. Another result not predicted by the foregoing analysis was the within-subject self-punitive effect observed for AS-PNP animals in the initial segment during Experiment 2 (see Figure 14). While post-hoc additions to the assumptions of earlier paragraphs might "explain" these discrepant results, the need for further research is obvious. Nonetheless, the prediction that alcohol can serve as a discriminable stimulus to produce self-punitive behavior in a within-subjects design is supported by the data from these experiments.

SUMMARY AND CONCLUSIONS

Animals for whom alcohol consumption was followed by punished "extinction" trials and sugar water by nonpunished trials (AP-SNPs) ran more quickly through the initial alley segment on trials of both types than did animals for whom drug state was not a reliable indicator of impending shock (AS-PNPs). Animals for whom alcohol consumption was followed by nonpunished trials and sugar water by punished trials (SP-ANPs) ran more quickly through the initial segment than AS-PNPs only on punished trials. Thus a within-subjects self-punitive effect was obtained only with SP-ANP rats. One may conclude that alcohol acted both as a stimulus and as an incapacitator. The stimulus properties of alcohol resulted in the drug cues eliciting fear and running if the drug was paired with punishment, but inhibiting running if alcohol was paired with nonpunishment. The alcohol-produced motor deficit always slowed running after alcohol consumption.

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APPENDIX A

Data and Analysis of Variance Summary Tables for Experiment 1

Table A1

Mean Running Speeds (cm/sec) during Shock-Escape Training After Consumption of Ethanol or Sugar Solutions by Animals Subsequently Assigned to One of Three Treatment Groups

	4.75% Ethanol				Sugar Water			
Group	Start	Initial	Middle	Final	Start	Initial	Middle	Final
SP-ANP								
1	23.8	98.5	87.9	88.3	43.6	110.1	116.2	102.1
13	26.4	109.3	106.9	107.8	41.7	124.5	144.3	125.2
2	18.0	100.0	91.9	84.4	7.1	106.1	108.1	107.6
8	20.9	84.3	78.2	58.3	19.2	112.1	121.7	95.7
16	35.9	107.8	108.7	91.0	26.4	107.8	105.7	94.4
AP-SNP								
3	20.6	120.3	158.5	129.5	40.6	159.0	179.4	152.9
9	22.2	137.4	182.6	143.4	42.0	153.6	194.2	161.6
15	20.6	111.8	125.8	102.6	50.5	133.0	151.9	113.1
4	35.7	136.2	135.6	86.8	11.7	147.1	160.2	111.3
14	43.6	115.1	124.5	107.1	20.7	113.7	121.9	93.9
AS-PNP								
6	32.3	112.7	112.7	67.4	7.4	113.6	127.3	95.8
12	30.6	140.9	182.2	117.5	23.9	117.5	151.0	125.0
5	24.1	150.3	181.6	146.3	49.1	149.7	197.0	145.2
11	19.2	74.1	66.0	53.8	33.5	104.9	79.6	62.9
17	2.3	105.0	118.8	101.7	45.4	154.0	170.0	135.6

Table A2

Starting Section Mean Running Speeds During Shock-Escape Training: Subsequent Group Assignment by Drinking Solution Analysis of Variance

Source	SS	DF	MS	F
Between subjects	1313.526	14		
Treatment group	122.832	2	61.416	.61
Error	1190.693	12	99.224	
Within subjects	3484.639	15		
Drinking solution	248.832	1	248.832	.94
Group X Solution	77.536	2	38.768	.14
Error	3158.270	12	263.189	

Table A3

Initial Segment Speeds During Shock-Escape Training:

Extinction-phase Group Assignment by Drinking Solution Analysis

Source	SS	DF	MS	F
Between subjects	9512.326	14		
Treatment group	3608.601	2	1804.300	3.66
Error	5903.725	12	491.977	
Within subjects	3698.914	15		
Drinking solution	1372.821	1	1372.821	7.23*
Group X Solution	48.867	2	24.433	.12
Error	2277.226	12	189.768	

*$p < .05$

Table A4

Middle Segment Speeds During Shock-Escape Training:

Extinction-phase Group Assignment by Drinking Solution Analysis

Source	SS	DF	MS	F
Between subjects	33577.349	14		
Treatment group	11282.132	2	5641.066	3.03
Error	22295.217	12	1857.934	
Within subjects	5224.412	15		
Drinking solution	2369.007	1	2369.007	10.63*
Group X Solution	182.870	2	91.435	.41
Error	2672.534	12	222.711	

*$p < .01$

Table A5

Final Segment Speeds During Shock-Escape Training:

Extinction-phase Group Assignment by Drinking Solution Analysis

Source	SS	DF	MS	F
Between subjects	19307.275	14		
Treatment group	3110.071	2	1555.035	1.15
Error	16197.204	12	1349.767	

Table A5, continued

Within subjects	3154.510	15		
Drinking solution	1865.512	1	1865.512	18.07*
Group X Solution	50.592	2	25.296	.24
Error	1238.405	12	103.200	

*p < .01

Table A6

Extinction-phase Starting Section Speeds (cm/sec) for Animals in each Treatment Group with Shock or No Shock Present in the Middle Segment

Four-day block	SP-ANP Subject: 1	13	2	8	16
1	32.6	50.5	3.4	48.6	37.5
2	35.7	1.7	.7	35.9	42.8
3	40.9	1.4	.7	50.5	48.6
4	30.4	10.6	.7	32.4	47.0
5	36.0	5.5	.7	41.7	34.8
6	42.8	3.2	.7	.4	37.5
1	34.5	35.7	.9	29.2	39.4
2	33.1	24.5	.7	36.8	32.8
3	36.5	10.3	.7	28.3	43.6
4	36.9	.8	.7	40.1	34.6
5	37.5	7.7	.7	35.9	52.1
6	37.4	5.5	.7	21.2	40.6

	AP-SNP Subject: 3	9	15	4	14
1	26.4	30.6	48.6	31.4	48.6
2	40.6	48.6	30.4	38.5	40.1
3	42.8	37.4	56.2	35.9	56.2
4	34.5	24.7	59.0	33.1	67.0
5	47.7	28.1	45.4	37.1	48.9
6	45.8	.7	39.1	37.5	45.4
1	43.4	31.7	44.2	17.0	40.1
2	39.6	1.6	35.9	37.1	41.7
3	30.6	6.1	45.4	38.5	45.8
4	29.8	10.8	38.7	40.1	38.7
5	42.0	.7	34.1	31.7	42.8
6	41.7	.7	27.2	35.8	38.7

Table A6, continued

AS-PNP

Subject:	6	12	5	11	17
1	18.1	34.8	37.5	47.7	50.0
2	37.1	34.8	18.4	35.5	11.5
3	28.6	43.6	12.7	34.5	6.3
4	30.6	38.7	14.0	31.0	29.2
5	20.5	37.1	2.3	34.6	13.7
6	26.7	30.1	1.1	28.6	25.6
1	35.9	44.2	35.9	26.5	50.5
2	28.8	33.6	21.6	37.4	37.1
3	13.1	40.6	35.5	50.0	59.0
4	38.4	41.7	9.2	40.1	35.7
5	33.3	45.4	22.2	50.6	45.8
6	43.6	34.0	.7	44.2	50.5

Note. Scores listed forst for each subject are speeds on trials when no shock was present in the middle segment; scores listed second are speeds on trials when the middle segment was electrified.

Table A7

Three-way Analysis of Starting Section Speeds during Extinction

Source	SS	DF	MS	F
Between subjects	26832.06	14		
Treatment group	3722.61	2	1861.30	.96
Error	23109.45	12	1925.78	
Within subjects	18307.51	165		
"Punishment"	.00	1	.00	.00
Group X "Punishment"	2295.75	2	1147.87	9.14*
Error	1505.52	12	125.46	
Days	1331.40	5	266.28	2.19
Group X Days	417.37	10	41.73	.34
Error	7281.34	60	121.35	
"Punishment" X Days	313.79	5	62.75	.84
Group X "Punishment" X Days	724.74	10	72.47	.97
Error	4437.57	60	73.95	

*p < .01

Table A8

Followup of Treatment Group by "Punishment" Interaction:

A Newman-Keuls Test on Group Totals in the Starting Section

	736	753	813	950	1084	1204
736		17	77	214*	348*	468*
753			60	197*	331*	451*
813				137*	271*	391*
950					134*	254*
1084						120*
$q_{.99}(r,12)\sqrt{nMS_{error}}$ =		108.2	126.2	137.8	146.3	152.8

*$\underline{p}$ < .01

Table A9

Initial Segment Speeds (cm/sec) during Extinction for Animals

in each Group With or Without Impending Punishment

Four-day block	SP-ANP Subj.: 1	13	2	8	16
1	98.8	127.3	128.8	122.0	100.2
2	54.0	25.0	141.9	150.7	57.0
3	82.0	42.1	130.7	152.8	58.6
4	64.4	54.8	145.2	148.8	53.8
5	60.0	20.8	113.8	134.9	23.2
6	47.4	56.8	114.2	101.2	4.1
1	114.5	132.6	128.3	140.0	94.6
2	85.7	127.3	147.0	179.4	93.3
3	96.8	128.0	156.5	174.4	129.8
4	113.1	129.8	161.0	162.3	127.1
5	113.4	138.6	190.6	165.0	96.4
6	96.2	132.8	186.4	174.4	4.1

Note. The first sequence of four-day blocks represents speeds on trials with no impending punishment; the second sequence represents speeds on trials with impending punishment.

Table A9, continued

AP-SNP

Subject:	3	9	15	4	14
1	170.0	145.1	129.8	141.2	120.0
2	161.0	141.9	71.2	137.6	122.0
3	170.0	78.3	122.8	152.5	130.3
4	151.0	27.0	128.0	156.5	135.6
5	179.4	4.1	109.8	146.6	149.0
6	170.0	4.1	83.1	148.8	138.6
1	148.8	138.4	120.0	122.0	118.0
2	174.7	51.2	91.6	139.8	129.8
3	165.0	37.7	117.5	138.9	136.2
4	166.0	11.6	115.4	156.5	138.9
5	179.4	4.1	105.2	161.0	145.6
6	174.4	4.1	111.2	165.0	136.2

AS-PNP

Subject:	6	12	5	11	17
1	152.8	129.8	101.8	19.0	170.2
2	32.2	130.0	97.4	4.1	146.6
3	19.2	141.9	102.1	4.1	86.4
4	43.0	145.6	111.2	4.1	86.4
5	44.6	161.0	113.3	4.1	138.6
6	81.5	130.3	133.6	4.1	4.1
1	143.8	138.0	101.8	19.0	170.2
2	75.6	127.6	84.8	4.1	146.6
3	70.9	141.9	94.6	4.1	156.5
4	58.1	154.0	107.4	4.1	161.0
5	7.4	161.0	112.8	4.1	108.9
6	1.8	148.8	132.8	4.1	4.1

Table A10

Three-way Analysis of Initial Segment Speeds during Extinction

Source	SS	DF	MS	F
Between subjects	334860.77	14		
Treatment group	35545.81	2	17772.90	.71
Error	299314.95	12	24942.91	
Within subjects	179303.04	165		
"Punishment"	8590.51	1	8590.51	15.56**
Group X "Punishment"	20018.10	2	10009.05	18.13***
Error	6622.77	12	551.89	

Table A10, continued

Days	17049.28	5	3409.85	2.10
Group X Days	3571.34	10	357.13	.22
Error	96975.89	60	1616.26	
"Punishment" X Days	2460.81	5	492.16	1.64
Group X "Punishment" X Days	6081.60	10	608.16	2.03*
Error	17932.70	60	298.87	

*$p < .05$
**$p < .01$
***$p < .001$

Table A11

Analysis of Running Speeds during Block 1 of Extinction

Source	SS	DF	MS	F
Between subjects	34583.824	14		
Treatment group	2365.808	2	1182.904	.44
Error	32218.016	12	2684.834	
Within subjects	905.530	15		
"Punishment"	20.833	1	20.833	.54
Group X "Punishment"	428.248	2	214.124	5.62*
Error	456.448	12	38.037	

*$p < .05$

Table A12

Newman-Keuls Followup of the Treatment Group by Punishment Interaction

on Block 1 of Extinction in the Initial Segment

	114.7	115.1	115.4	121.8	129.4	141.2
114.7		.4	.7	7.1	14.7*	26.5*
115.1			.3	6.7	14.3*	26.1*
115.4				6.4	14.0	25.8*
121.8					7.6	19.4*
129.4						11.8*
$q_{.95}(r,12)\sqrt{MS_{error}/n}$ =		8.5	10.4	11.6	12.4	13.1

*$p < .05$

Table A13

Analysis of Running Speeds through the Initial Segment during Block 6 of Extinction

Source	SS	DF	MS	F
Between subjects	111959.798	14		
Treatment group	12069.208	2	6034.604	.72
Error	99890.590	12	8324.215	
Within subjects	13250.335	15		
"Punishment"	2159.008	1	2159.008	4.84*
Group X "Punishment"	5740.564	2	2870.282	6.43*
Error	5350.762	12	445.896	

*$p < .05$

Table A14

Followup of the Treatment Group by Punishment Interaction on Block 6 of Extinction in the Initial Segment: A Newman-Keuls Test

	58.3	64.7	70.7	108.9	118.2	118.8
58.3		6.4	12.4	50.6*	59.9*	60.5*
64.7			6.0	44.2*	53.5*	54.1*
70.7				38.2*	47.5*	48.1*
108.9					9.3	9.9
118.2						.6
$q_{.95}(r,12)\sqrt{MS_{error}/n}$ =	29.1	35.6	39.7	42.6	44.8	

*$p < .05$

Table A15

A Test of the Significance of Changes in Initial Segment Speeds during Extinction (Block 1 - Block 6 Difference Scores) using Randomization Tests for Matched Pairs

	Difference scores by treatment group		
	SP-ANP	AP-SNP	AS-PNP
Trials with impending punishment	18.3	-25.6	142.0
	- .2	134.3	-10.8
	-59.1	8.8	-23.7
	-34.4	-43.0	11.2
	90.5	-18.2	165.3
	15.1	56.3	284.0
Trials with no impending punishment	51.4	0.0	71.3
	70.5	141.0	- .5
	14.6	46.7	-31.8
	20.8	- 7.6	14.9
	96.1	-18.6	166.1
	253.4*	161.5	220.0

Note. With N = 5, there are 32 possible permutations of the differences. Thus a two-tailed test requires the most extreme sum of the differences at either end of the sampling distribution to justify rejection of the null hypothesis.

*$p < .05$

Table A16

Speeds (cm/sec) through the Middle Segment on Punished and Nonpunished Trials during Extinction

Four-day block	SP-ANP				
	1	13	2	8	16
1	65.8	123.9	113.1	109.5	81.6
2	46.4	38.0	136.2	87.0	32.4
3	70.0	34.8	117.0	135.6	86.4
4	63.4	76.8	141.9	138.6	95.4
5	64.0	37.4	110.7	142.6	31.6
6	48.8	52.2	91.8	93.5	4.1

Table A16, continued

1	124.9	132.6	186.5	155.8	92.6
2	118.5	145.6	182.2	185.0	138.9
3	120.8	148.8	175.6	161.0	156.5
4	119.6	152.5	174.5	160.5	152.8
5	122.3	142.6	174.5	145.6	105.0
6	115.4	141.9	185.0	157.3	4.1

AP-SNP

Subject:	3	9	15	4	14
1	170.0	179.4	132.6	149.6	127.3
2	152.5	141.9	60.8	122.6	120.0
3	158.8	78.6	119.6	135.6	132.6
4	185.0	32.0	135.6	138.6	127.3
5	186.2	4.1	133.6	104.2	139.4
6	180.0	4.1	81.0	113.1	130.3
1	195.0	200.4	145.7	139.2	138.9
2	193.8	73.4	128.0	148.2	127.1
3	203.3	141.2	160.5	145.6	157.3
4	197.0	45.6	146.6	142.6	152.5
5	210.6	4.1	138.6	148.8	145.2
6	217.9	4.1	135.6	149.6	136.6

AS-PNP

Subject:	6	12	5	11	17
1	159.0	130.3	86.0	30.7	183.4
2	98.6	56.4	79.3	4.1	142.6
3	121.0	141.9	85.8	4.1	145.6
4	174.4	135.6	107.8	4.1	110.2
5	138.0	134.0	103.5	4.1	156.5
6	174.4	96.6	117.4	4.1	4.1
1	137.3	157.1	103.4	31.4	190.6
2	136.2	134.8	82.8	4.1	182.2
3	167.9	160.5	104.5	4.1	170.0
4	185.0	146.2	120.8	4.1	153.4
5	177.7	165.2	118.6	4.1	141.2
6	159.0	162.3	138.6	4.1	4.1

Note. Scores listed first for each subject are speeds on trials when no shock was present in the middle segment; scores listed second are speeds on trials when the middle segment was electrified.

Table A17

Three-way Analysis of Middle Segment Speeds during Extinction

Source	SS	DF	MS	F
Between subjects	299405.37	14		
Treatment group	22336.22	2	11168.11	.48
Error	277069.14	12	23089.09	
Within subjects	235959.97	165		
Punishment	47456.52	1	47456.52	87.06**
Group X Punishment	17447.72	2	8723.86	16.00**
Error	6540.93	12	545.07	
Days	24101.66	5	4820.33	2.66*
Group X Days	6469.67	10	646.96	.35
Error	108442.65	60	1807.37	
Punishment X Days	3236.64	5	647.32	1.91
Group X Punishment X Days	2002.83	10	200.28	.59
Error	20261.31	60	337.68	

*$p < .05$
**$p < .001$

Table A18

Newman-Keuls Followup of the Group by Punishment Interaction for

Middle Segment Speeds during Extinction

	2530	2932	3448	3673	4270	4276
2530		402*	918*	1143*	1740*	1746*
2932			516*	741*	1338*	1344*
3448				225*	822*	828*
3673					597*	603*
4270						6
$q_{.95}(r,12)\sqrt{nMS_{error}}$ =		176.5	212.6	240.6	258.4	272.2

*$p < .05$

Table A19

Final Segment Running Speeds (cm/sec) on Punished and Nonpunished

Trials during Extinction

SP-ANP

Four-day block	Subj.: 1	13	2	8	16
1	43.0	59.0	90.0	68.8	69.4
2	47.0	38.8	113.1	111.6	27.4
3	61.0	41.0	96.8	93.2	80.8
4	55.8	53.2	115.4	107.8	87.6
5	52.2	41.0	72.6	102.2	4.1
6	39.5	47.2	72.6	76.8	4.1
1	84.4	80.1	109.8	107.4	68.2
2	87.3	71.2	147.0	170.0	115.2
3	85.9	80.0	142.6	127.3	136.2
4	83.7	89.4	142.6	120.0	120.0
5	79.2	95.7	136.2	114.4	92.5
6	80.3	120.0	139.8	113.6	4.1

AP-SNP

	Subject: 3	9	15	4	14
1	121.9	132.8	113.0	90.0	95.4
2	106.3	109.8	42.1	31.6	95.3
3	165.0	88.6	95.7	78.6	109.8
4	156.5	59.2	81.0	57.6	113.1
5	175.7	4.1	58.0	30.2	118.4
6	152.5	4.1	32.1	49.8	95.4
1	115.2	143.8	104.6	84.4	98.5
2	156.8	48.6	96.8	87.0	93.8
3	169.4	122.4	113.1	95.4	111.0
4	170.0	37.5	101.8	81.6	103.4
5	175.6	4.1	84.8	91.7	107.2
6	171.6	4.1	85.5	104.2	95.6

AS-PNP

	Subject: 6	12	5	11	17
1	67.1	29.8	141.9	117.5	98.8
2	38.0	4.1	128.8	52.2	31.2
3	41.0	4.1	135.6	85.8	116.2
4	57.0	4.1	108.9	127.3	113.6
5	43.8	4.1	141.9	110.4	92.6
6	76.0	4.1	4.1	137.2	52.6

Table A19, continued

1	73.0	29.3	138.9	90.4	100.6
2	44.2	4.1	170.8	92.8	92.0
3	54.2	4.1	161.0	122.2	131.2
4	70.9	4.1	164.2	157.3	119.4
5	61.6	4.1	149.6	120.0	139.2
6	77.8	4.1	4.1	132.8	125.2

Note. Scores listed first for each subject are speeds on trials when no shock was present in the middle segment; scores listed second are speeds on trials when the middle segment was electrified.

Table A20

Analysis of Speeds (cm/sec) through the Final Segment during Extinction

Source	SS	DF	MS	F
Between subjects	201602.44	14	14400.17	
Treatment group	6957.65	2	3478.82	.21
Error	194644.79	12	16220.39	
Within subjects	158927.04	165	963.19	
Punishment	21377.08	1	21377.08	42.56**
Group X Punishment	4855.64	2	2427.82	4.83*
Error	6026.38	12	502.19	
Days	15918.57	5	3183.71	2.26
Group X Days	8600.93	10	860.09	.61
Error	84246.04	60	1404.10	
Punishment X Days	3288.21	5	657.64	2.85*
Group X Punishment X Days	795.71	10	79.57	.34
Error	13818.43	60	230.30	

*$p < .05$
**$p < .001$

Table A21

Treatment Group by Punishment Interaction, Newman-Keuls Followup Test

	2039	2167	2640	2661	3058	3141
2039		128	601*	622*	1019*	1102*
2167			473*	494*	891*	974*
2640				21	418*	501*
2661					397*	480*
3058						83
$q_{.95}(r,12)\sqrt{nMS_{error}}$ =	154.4	188.9	210.5	226.0	238.0	

$^*p < .05$

Table A22

Mean Weight (g) of Animals in each Group throughout the Experiment

Group	Initial	Exposure	Training	1	2	3	4	5	6
SP-ANP									
1	224	192	200	212	223	234	240	246	248
13	218	203	208	229	242	245	250	252	257
2	212	202	216	221	231	244	248	255	256
8	222	190	191	208	222	233	231	241	243
16	226	210	216	230	232	245	250		
AP-SNP									
3	234	227	239	249	249	253	277	273	276
9	226	204	209	222	239	253	258		
15	198	188	189	201	212	218	225	227	234
4	224	207	220	230	240	248	259	258	260
14	236	208	218	230	229	233	240	245	250
AS-PNP									
6	216	199	213	218	230	245	247	250	256
12	218	216	216	225	237	252	257	260	261
5	226	211	225	236	252	252	268	274	267
11	242	225	231	242	254	269	276	280	281
17	222	212	208	225	244	254	262		

Table A23

Groups by Blocks of Four Days Analysis of Weights from

Exposure Days through Block 4 of Extinction

Source	SS	DF	MS	F
Between subjects	12127.822	14		
Treatment group	2708.422	2	1354.211	1.72
Error	9419.400	12	784.950	
Within subjects	26138.666	75		
Blocks	24607.288	5	4921.457	237.25*
Group X Blocks	286.777	10	28.677	1.38
Error	1244.600	60	20.743	

*$p < .001$

Table A24

Groups by Blocks Analysis of Weights for Blocks 5 and 6 of Extinction

Source	SS	DF	MS	F
Between subjects	4534.125	11		
Treatment group	1269.250	2	634.625	1.74
Error	3264.875	9	362.763	
Within subjects	111.500	12		
Blocks	40.041	1	40.041	5.91*
Group X Blocks	10.583	2	5.291	.78
Error	60.875	9	6.763	

*$p < .05$

Table A25

Fluid Consumption for Subjects of each Group on each Four-day Block

Four-day block			SP-ANP		
	1	13	2	8	16
Exposure	13.0	9.0	13.0	11.5	7.0
Training	16.0	18.0	17.0	12.0	9.5
1	16.0	22.0	16.0	19.0	17.0
2	18.0	24.0	20.0	16.5	12.5
3	19.5	20.0	20.0	8.5	17.0
4	17.5	22.5	19.5	14.0	15.0
5	18.5	18.5	21.5	17.0	14.0
6	17.0	18.5	17.0	12.0	
Exposure	8.5	16.5	17.0	10.5	18.0
Training	19.0	18.0	16.0	14.0	21.0
1	20.5	21.0	21.5	17.5	23.5
2	22.0	24.0	24.0	23.0	24.0
3	23.0	22.5	27.0	23.0	25.5
4	24.0	24.5	25.0	22.0	26.5
5	18.0	23.0	27.5	22.0	20.0
6	23.0	21.5	27.0	21.0	
			AP-SNP		
Subject:	3	9	15	4	14
Exposure	12.5	7.5	12.0	15.5	9.0
Training	17.0	15.5	14.5	16.5	15.0
1	11.5	18.5	15.0	18.0	16.0
2	10.0	19.0	16.0	15.0	14.0

Table A25, continued

3	19.5	20.5	19.0	21.0	14.0
4	17.0	22.5	19.0	21.5	16.0
5	13.0		19.0	19.0	18.5
6	19.0		18.0	14.5	15.5
Exposure	19.5	13.0	15.5	16.5	15.0
Training	20.5	17.0	21.0	21.0	15.5
1	24.5	21.0	16.5	23.5	16.5
2	22.0	23.0	21.5	22.5	14.5
3	24.5	24.5	22.5	26.0	18.0
4	22.5	22.5	24.0	25.0	19.5
5	21.5		27.5	22.0	16.5
6	22.0		24.0	25.0	17.5

AS-PNP

Subject:	6	12	5	11	17
Exposure	11.0	11.5	11.5	11.5	9.5
Training	18.5	8.0	15.0	20.0	16.5
1	9.0	17.0	17.0	18.5	20.0
2	20.0	17.5	17.5	21.0	
3	18.0	18.5	17.5	22.0	
4	16.5	19.0	17.0	20.5	
5	15.0	21.5	19.0	22.0	
6	16.5	19.0		18.5	
Exposure	19.0	15.0	20.0	17.5	16.5
Training	22.5	16.0	18.0	18.5	21.0
1	23.0	18.5	26.0	16.5	16.5
2	23.5	21.0	25.0	21.5	
3	26.5	22.5	26.5	24.0	
4	28.0	21.0	26.5	22.5	
5	24.5	21.0	25.5	24.5	
6	28.0	19.0		23.5	

Note. Scores listed first for each subject indicate amounts (ml) of 4.75% ethanol consumed; secondly-listed scores are amounts (ml) of sugar water consumed.

Table A26

Analysis of Fluid Consumption during Exposure Days

Source	SS	DF	MS	F
Between subjects	103.116	14		
Treatment group	18.466	2	9.233	1.30
Error	84.650	12	7.054	

Table A26, continued

Within subjects	288.250	15		
Drinking solution	177.633	1	177.633	21.85*
Group X Solution	13.066	2	6.533	.80
Error	97.550	12	8.129	

*p < .001

Table A27

Analysis of Fluid Consumption during Shock-Escape Training Days

Source	SS	DF	MS	F
Between subjects	152.866	14		
Treatment group	11.716	2	5.858	.49
Error	141.150	12	11.762	
Within subjects	167.500	15		
Drinking solution	83.333	1	83.333	11.92*
Group X Solution	.316	2	.158	.02
Error	83.850	12	6.987	

*p < .01

Table A28

Analysis of Fluid Consumption during Extinction

Source	SS	DF	MS	F
Between subjects	403.44	14		
Treatment group	53.17	2	26.58	.91
Error	350.27	12	29.18	
Within subjects	2239.34	165		
Drinking solution	1149.12	1	1149.12	43.81*
Group X Solution	5.32	2	2.66	.10
Error	314.74	12	26.22	
Days	141.38	5	28.27	6.66*
Group X Days	64.33	10	6.43	1.51
Error	254.74	60	4.24	
Solution X Days	27.93	5	5.58	1.35
Group X Solution X Days	34.56	10	3.45	.83
Error	247.19	60	4.11	

*p < .001

Table A29

Mean Ethanol Dosage (g/kg) for each Block of Four Days throughout the Experiment

Group	Exposure	Training	1	2	3	4	5	6
SP-ANP								
1	2.58	2.96	2.82	3.00	3.12	2.72	2.82	2.55
13	1.64	3.22	3.56	3.71	3.06	3.34	2.76	2.94
2	2.35	3.00	2.68	3.22	3.07	2.92	3.11	2.51
8	2.24	2.36	3.46	2.78	1.34	2.24	2.62	1.85
16	1.21	1.60	2.80	2.00	2.56	2.26	2.02	2.14
AP-SNP								
3	1.36	2.77	3.10	2.96	3.02	3.24	3.13	3.13
9	2.04	2.64	1.66	2.22	2.79	2.33		
15	2.42	2.80	2.80	2.82	3.24	3.14	3.12	2.88
4	2.74	2.82	2.89	2.32	3.18	3.08	2.71	2.13
14	1.58	2.56	2.60	2.28	2.22	2.46	2.82	2.34
AS-PNP								
6	2.02	3.30	1.50	3.23	2.76	2.46	2.20	2.44
12	1.96	1.40	2.83	2.74	2.74	2.75	3.10	2.72
5	2.02	2.48	2.64	2.60	2.60	2.35	2.57	2.46
11	1.90	3.20	2.87	3.08	3.06	2.76	2.94	2.41
17	1.64	2.89	3.35					

Table A30

Analysis of Variance for Dosage

Source	SS	DF	MS	F
Between subjects	9.154	14		
Treatment group	.009	2	.004	.00
Error	9.145	12	.762	
Within subjects	22.867	105		
Days	7.942	7	1.134	7.25*
Group X Days	1.794	14	.128	.81
Error	13.130	84	.156	

*$p < .001$

Table A31

Initial Segment Mean Speeds (cm/sec) for the First Trial Each Day of Extinction after Consumption of 4.75% Ethanol or Sugar Water

Four-day block	1	13	2	8	16
			SP-ANP		
1	122.0	130.3	106.3	117.5	135.6
2	148.9	145.7	37.7	113.0	62.0
3	125.4	160.5	47.5	101.3	67.3
4	138.6	152.9	6.3	37.5	53.4
5	125.9	153.2	21.8	60.0	62.0
6	123.8	97.1	4.1	15.8	77.6
1	124.6	140.1	71.3	108.9	141.9
2	139.6	198.6	78.0	80.8	125.8
3	156.5	179.4	129.8	74.1	117.3
4	175.6	162.3	89.8	95.7	141.9
5	190.6	185.0	55.5	79.2	149.6
6	161.0	174.4	4.1	98.0	136.2
			AP-SNP		
1	132.9	130.3	166.0	116.9	98.8
2	139.8	129.8	183.1	26.8	79.9
3	157.3	145.6	165.0	82.8	101.1
4	156.5	152.9	166.0	15.1	111.2
5	141.2	154.0	191.4	4.1	98.2
6	155.3	136.2	174.4	4.1	72.0
1	122.6	129.8	180.0	125.4	156.0
2	137.6	122.0	161.0	141.9	83.9
3	152.5	151.0	174.4	82.3	127.3
4	160.5	132.6	180.0	4.1	135.6
5	159.0	149.0	185.0	4.1	112.5
6	145.6	141.9	170.0	4.1	68.4
			AS-PNP		
1	136.2	88.6	161.0	113.6	21.0
2	74.7	34.7	145.0	96.8	2.8
3	162.3	24.9	145.2	60.2	4.1
4	126.5	54.6	23.2	103.4	4.1
5	100.9	14.0	77.3	89.8	4.1
6	92.1	1.6	8.1	101.0	4.1
1	150.7	166.0	180.0	105.2	6.0
2	147.1	17.2	181.9	100.0	4.1
3	145.6	10.9	165.0	108.9	4.1
4	154.0	31.1	161.0	122.2	4.1
5	169.4	2.9	169.4	100.2	4.1
6	97.6	2.6	4.1	127.3	4.1

Table A32

Analysis of Initial Segment Speeds on the First Trial each

Day of Extinction

Source	SS	DF	MS	F
Between subjects	399068.92	14		
Treatment group	61593.88	2	30796.94	1.09
Error	337475.03	12	28122.91	
Within subjects	196598.82	165		
Drinking solution	17938.05	1	17938.05	21.23**
Group X Solution	5395.77	2	2697.88	3.19
Error	10135.59	12	844.63	
Days	29580.41	5	5916.08	4.02*
Group X Days	5842.30	10	584.23	.39
Error	88095.29	60	1468.25	
Solution X Days	2336.37	5	467.27	.90
Group X Solution X Days	6400.38	10	640.03	1.24
Error	30874.62	60	514.57	

*$p < .01$
**$p < .001$

APPENDIX B

Data and Analysis of Variance Summary Tables for Experiment 2

Table B1

Mean Running Speeds (cm/sec) in each Alley Segment during Shock-Escape Training after Consumption of 3% Ethanol or Sugar Water by Animals Subsequently Assigned to One of Three Treatment Groups

	3.17% Ethanol				Sugar Water			
Group	Start	Initial	Middle	Final	Start	Initial	Middle	Final
SP-ANP								
32	26.4	123.1	134.5	121.3	34.5	116.1	113.0	88.9
38	21.0	120.8	123.5	103.7	21.0	132.9	135.6	127.1
44	40.6	129.8	138.9	107.8	43.6	138.6	145.2	132.6
35	20.7	93.7	103.5	108.4	30.4	107.2	125.0	101.8
45	37.1	130.3	137.2	122.0	34.5	135.6	160.5	121.8
49	18.5	166.0	217.9	197.0	23.4	128.0	180.0	148.3
50	18.9	110.5	135.4	114.4	42.5	89.7	71.0	63.0
AP-SNP								
33	31.2	145.6	145.2	117.5	30.6	128.0	107.8	100.2
39	12.5	95.6	100.1	83.8	26.2	96.8	111.2	84.0
43	44.2	115.5	114.4	101.8	48.6	118.0	121.9	114.0
36	22.8	145.7	156.5	125.0	25.0	145.2	152.9	130.3
40	31.4	111.2	108.4	83.1	27.2	124.5	124.5	107.3
46	11.2	96.8	138.6	111.8	16.4	129.8	146.6	129.1
47	43.6	152.5	162.3	136.2	15.4	105.7	134.6	122.1
AS-PNP								
31	34.0	143.3	151.6	141.5	26.9	132.9	151.2	142.5
37	42.9	127.3	132.9	122.0	32.6	124.5	146.6	127.3
41	25.9	152.7	179.7	141.9	37.1	160.5	191.4	166.0
51	26.3	122.8	135.6	115.1	21.5	108.7	112.5	112.9
34	26.2	131.3	137.3	127.1	50.5	120.0	122.2	115.1
42	35.9	120.8	139.8	125.2	15.3	129.8	152.9	138.6
48	34.5	138.6	165.0	129.8	31.7	152.5	179.4	148.9

Table B2

Starting Section Mean Running Speeds during Shock-Escape Training: Subsequent Group Assignment by Drinking Solution Analysis of Variance

Source	SS	DF	MS	F
Between subjects	2482.026	20		
Treatment group	108.059	2	54.029	.40
Error	2373.967	18	131.887	

Table B2, continued

Within subjects	1568.135	21		
Drinking solution	20.162	1	20.162	.25
Group X Solution	146.920	2	73.460	.94
Error	1401.052	18	77.836	

Table B3

Initial Segment Speeds during Shock-Escape Training: Subsequent

Group Assignment by Drinking Solution Analysis of Variance

Source	SS	DF	MS	F
Between subjects	10395.591	20		
Treatment group	1063.251	2	531.625	1.02
Error	9332.340	18	518.463	
Within subjects	3455.605	21		
Drinking solution	56.933	1	56.933	.30
Group X Solution	12.040	2	6.020	.03
Error	3386.631	18	188.146	

Table B4

Middle Segment Speeds during Shock-Escape Training: Subsequent

Group Assignment by Drinking Solution Analysis of Variance

Source	SS	DF	MS	F
Between subjects	24525.850	20		
Treatment group	2741.230	2	1370.615	1.13
Error	21784.620	18	1210.256	
Within subjects	5692.135	21		
Drinking solution	124.459	1	124.459	.41
Group X Solution	200.744	2	100.372	.33
Error	5366.931	18	298.162	

Table B5

Shock-Escape Training Speeds in the Final Segment: Subsequent

Group Assignment by Drinking Solution Analysis of Variance

Source	SS	DF	MS	F
Between subjects	17518.993	20		
Treatment group	3465.203	2	1732.601	2.21
Error	14053.790	18	780.766	

Table B5, continued

Within subjects	5066.360	21		
Drinking solution	5.075	1	5.075	.02
Group X Solution	812.334	2	406.167	1.72
Error	4248.950	18	236.052	

Table B6

Extinction Phase Starting Section Speeds (cm/sec) for Animals in each Group with Shock or No Shock Present in the Middle Segment

Four-day block	SP-ANP						
	35	45	49	32	38	44	50
1	34.7	38.3	7.6	42.0	11.8	30.3	34.5
2	43.6	22.2	25.7	38.7	12.2	24.9	37.2
3	35.5	21.2	31.4	.7	6.4	38.5	38.7
4	20.7	41.7	35.7	.7	.7	40.1	29.2
5	28.7	45.4	35.9	.7	.7	27.2	31.7
6	43.6	35.9	19.6	.7	.7	40.1	13.5
1	35.9	31.2	13.5	45.8	11.1	40.1	29.5
2	45.6	28.7	45.4	43.6	12.8	37.4	37.5
3	56.2	47.7	41.7	.7	.7	47.7	45.4
4	50.0	33.9	38.5	.7	.7	45.8	39.7
5	47.7	40.1	37.1	.7	.7	45.4	37.1
6	55.6	37.1	45.8	.7	.7	47.0	6.7
	AP-SNP						
1	33	39	43	47	36	40	46
1	59.0	40.6	60.7	44.2	14.3	25.2	29.4
2	48.6	50.0	67.0	48.6	39.3	18.7	31.7
3	.7	25.3	45.8	45.8	35.0	.7	22.8
4	.7	45.6	52.8	40.6	34.7	.7	25.7
5	.7	.7	50.0	45.4	42.9	.7	17.3
6	.7	.7	45.8	40.1	47.7	.7	1.5
1	47.7	33.9	42.9	42.6	27.2	34.7	27.2
2	42.0	37.5	43.6	40.6	25.7	15.6	31.9
3	.7	42.0	45.6	42.9	41.7	.7	1.8
4	.7	19.6	52.1	38.5	40.6	.7	20.3
5	.7	.7	45.4	40.1	43.6	.7	16.6
6	.7	.7	41.7	38.5	47.7	.7	4.6

Note. Speeds listed second are prior to punishment.

Table B6, continued

AS-PNP

	31	37	41	51	34	42	48
1	28.7	35.9	19.7	19.4	52.8	43.6	22.8
2	27.2	.7	23.1	31.4	47.7	47.0	37.1
3	31.2	.7	.7	21.2	45.4	52.8	44.2
4	44.2	.7	.7	18.2	62.5	50.5	33.9
5	47.0	.7	.7	.7	55.6	50.0	40.6
6	34.7	.7	.7	.7	47.7	52.8	38.4
1	26.2	30.5	38.4	27.7	45.8	40.6	27.6
2	38.1	1.4	45.1	25.7	50.0	44.2	40.6
3	40.6	.7	.7	21.3	56.2	44.2	47.0
4	33.9	.7	.7	2.5	52.1	56.2	42.0
5	43.6	.7	.7	.7	56.6	45.4	38.4
6	45.6	.7	.7	.7	52.8	47.7	40.6

Table B7

Three-way Analysis of Starting Section Speeds during Extinction

Source	SS	DF	MS	F
Between subjects	54258.14	20	2712.90	
Treatment group	71.65	2	35.82	.01
Error	54186.49	18	3010.36	
Within subjects	34270.58	231		
"Punishment"	96.20	1	96.20	1.61
Group X "Punishment"	801.81	2	400.90	6.74**
Error	1069.26	18	59.40	
Days	4083.37	5	816.67	3.15*
Group X Days	1609.00	10	160.90	.62
Error	23279.13	90	258.65	
"Punishment" X Days	136.27	5	27.25	.86
Group X "Punishment" X Days	345.88	10	34.58	1.09
Error	2849.63	90	31.66	

*$p < .05$
**$p < .01$

Table B8

Followup of Treatment Group by "Punishment" Interaction in the Starting Section: A Newman-Keuls Test

	1067	1120	1212	1246	1253	1308
1067		53	145*	179*	186*	241*
1120			92*	126*	133*	188*
1212				34	41	96*
1246					7	62
1253						55
$q_{.95}(r,12)\sqrt{nMS_{error}}$ =		60.6	73.6	81.6	87.3	91.6

*$p < .05$

Table B9

Initial Segment Speeds (cm/sec) during Extinction for Animals in each Group with Shock or No Shock present in the Middle Segment

Four-day block	SP-ANP						
	35	45	49	32	38	44	50
1	138.9	135.6	149.6	115.1	76.8	105.3	84.8
2	145.6	111.2	149.6	132.6	41.5	74.1	89.2
3	74.7	55.7	96.1	4.1	9.8	71.3	71.8
4	72.3	114.4	156.5	4.1	4.1	75.6	64.3
5	73.6	124.5	156.0	4.1	4.1	63.6	44.9
6	139.8	118.9	82.0	4.1	4.1	45.4	26.6
1	132.9	135.6	156.5	127.1	93.0	115.5	84.7
2	135.6	135.6	174.7	135.6	87.8	111.2	89.8
3	141.9	107.3	151.0	4.1	4.1	79.9	79.2
4	148.9	125.8	180.0	4.1	4.1	51.5	69.2
5	161.9	145.2	180.0	4.1	4.1	94.4	65.7
6	174.4	160.5	169.4	4.1	4.1	92.5	4.1

Note. Speeds listed second are those prior to shock-punishment in the middle segment.

Table B9, continued

AP-SNP

	33	39	43	47	36	40	46
1	170.0	117.5	129.8	145.2	150.7	110.9	134.2
2	160.5	120.0	127.3	132.7	154.3	12.5	148.9
3	4.1	46.9	141.9	160.5	157.3	4.1	87.3
4	4.1	64.9	141.9	165.0	160.5	4.1	148.9
5	4.1	4.1	162.8	156.5	156.5	4.1	157.3
6	4.1	4.1	142.6	165.0	174.4	4.1	91.7
1	161.0	56.0	115.5	152.9	157.3	105.7	138.6
2	74.5	120.0	124.5	169.4	169.4	27.1	169.2
3	4.1	96.8	54.0	156.5	152.9	4.1	90.1
4	4.1	4.6	127.3	165.0	174.4	4.1	145.2
5	4.1	4.1	130.3	165.0	179.4	4.1	161.0
6	4.1	4.1	141.9	156.5	186.4	4.1	97.4

AS-PNP

	31	37	41	51	34	42	48
1	152.5	60.1	88.6	99.9	110.9	148.9	149.6
2	142.1	4.1	11.2	48.4	111.8	109.4	154.0
3	100.2	4.1	4.1	38.1	47.6	141.9	152.9
4	141.9	4.1	4.1	3.9	115.1	135.6	149.6
5	152.9	4.1	4.1	4.1	122.0	156.5	152.9
6	160.5	4.1	4.1	4.1	114.4	145.2	132.6
1	157.3	64.3	152.9	122.8	110.2	136.2	146.6
2	149.1	4.1	10.8	111.8	107.3	104.8	152.5
3	129.8	4.1	4.1	52.5	90.8	142.6	161.0
4	141.9	4.1	4.1	35.2	108.7	148.9	152.5
5	152.9	4.1	4.1	4.1	122.0	141.9	152.5
6	161.0	4.1	4.1	4.1	129.8	154.0	149.6

Table B10

Analysis of Speeds through the Initial Segment during Extinction

Source	SS	DF	MS	F
Between subjects	655138.06	20		
Treatment group	8479.39	2	4239.69	.11
Error	646658.66	18	35925.48	
Within subjects	285442.22	231	1235.68	
"Punishment"	3561.77	1	3561.77	7.07*
Group X "Punishment"	5780.42	2	2890.21	5.73*
Error	9067.63	18	503.75	

Table B10, continued

Days	73835.17	5	14767.03	8.41**
Group X Days	8348.35	10	834.83	.47
Error	158001.99	90	1755.57	
"Punishment" X Days	800.68	5	160.13	.58
Group X "Punishment" X Days	1530.65	10	153.06	.56
Error	24515.52	90	272.39	

*p < .05
**p < .001

Table B11

Newman-Keuls Followup of Initial Segment Interaction

	3313	3594	3896	4129	4165	4336
3313	]	281*	583*	816*	852*	1023*
3594			302*	535*	571*	742*
3896				233*	269*	440*
4129					36	207
4165						171
$q_{.95}(r,18)\ /nMS_{error}$ =		176.4	214.4	237.6	254.2	266.7

*p < .05

Table B12

Speeds (cm/sec) through the Middle Segment on Punished and Nonpunished Trials for each Four-day Block of Extinction

Four-day block	SP-ANP						
	35	45	49	32	38	44	50
1	148.9	132.9	175.6	72.3	65.8	71.0	76.7
2	114.4	106.3	170.0	100.0	78.7	39.2	82.0
3	50.7	55.6	84.3	4.1	4.1	72.4	63.6
4	59.9	143.8	197.0	4.1	4.1	82.3	62.3
5	62.2	152.5	185.0	4.1	4.1	46.5	65.7
6	87.7	137.3	103.7	4.1	4.1	76.7	33.8

Table B12, continued

1	181.9	179.4	226.2	133.6	161.0	131.1	101.8
2	161.0	170.0	207.0	152.9	136.2	138.9	103.1
3	181.9	134.7	185.0	4.1	4.1	112.7	101.8
4	165.0	165.0	203.3	4.1	4.1	148.9	111.2
5	62.2	170.0	219.0	4.1	4.1	133.6	118.0
6	87.7	185.0	217.9	4.1	4.1	138.9	54.6

AP-SNP

	33	37	41	51	34	42	48
1	174.4	113.1	129.8	190.6	148.9	61.5	156.5
2	185.0	118.0	88.6	197.0	161.0	8.1	145.6
3	4.1	49.7	145.6	151.0	106.4	4.1	74.5
4	4.1	127.3	162.0	174.4	180.0	4.1	165.0
5	4.1	4.1	167.2	170.0	174.4	4.1	197.0
6	4.1	4.1	161.0	170.0	197.0	4.1	97.4
1	170.0	113.1	132.6	169.4	174.4	111.2	185.0
2	169.4	122.0	129.8	191.4	174.4	39.8	197.0
3	4.1	124.5	132.8	174.4	198.6	4.1	170.0
4	4.1	71.4	161.6	185.0	210.6	4.1	174.4
5	4.1	4.1	181.6	197.0	197.0	4.1	217.9
6	4.1	4.1	204.2	210.6	198.6	4.1	103.7

AS-PNP

	31	37	41	51	34	42	48
1	166.0	61.2	97.0	108.5	99.3	138.9	180.0
2	149.6	4.1	9.6	77.1	104.9	80.1	146.6
3	96.5	4.1	4.1	52.0	34.4	146.6	185.0
4	165.0	4.1	4.1	61.7	120.8	135.6	174.4
5	174.4	4.1	4.1	4.1	113.1	132.6	193.6
6	160.5	4.1	4.1	4.1	113.1	100.2	174.4
1	174.4	102.1	174.4	145.2	132.9	174.4	180.0
2	204.8	4.1	39.2	105.4	143.8	143.8	146.6
3	174.4	4.1	4.1	102.2	132.7	180.0	154.0
4	186.4	4.1	4.1	94.3	137.2	166.0	170.0
5	212.6	4.1	4.1	4.1	152.9	190.6	198.6
6	210.6	4.1	4.1	4.1	138.9	179.4	174.4

Note. Speeds listed second are those on trials when shock-punishment was present in the middle segment.

Table B13

Overall Analysis of Speeds through the Middle Segment during Extinction

Source	SS	DF	MS	F
Between subjects	824234.30	20		
Treatment group	13805.51	2	6902.75	.15
Error	810428.79	18	45023.82	
Within subjects	434315.80	231	1880.15	
Punishment	49978.93	1	49978.93	53.75**
Group X Punishment	8358.63	2	4179.31	4.49*
Error	16736.41	18	929.80	
Days	80483.29	5	16096.65	6.47**
Group X Days	10758.31	10	1075.83	.43
Error	223605.98	90	2484.51	
Punishment X Days	5258.46	5	1051.69	2.51*
Group X Punishment X Days	1052.07	10	150.20	.35
Error	37633.68	90	418.15	

*$p < .05$
**$p < .001$

Table B14

Newman-Keuls Followup of Treatment Group by Punishment Interaction in the Middle Segment during Extinction

	3287	3795	4585	4865	5112	5241
3287		508*	1298*	1578*	1825*	1954*
3795			790*	1070*	1317*	1446*
4585				280*	527*	656*
4865					247*	376*
5112						129
$q_{.95}(r,18)\sqrt{nMS_{error}}$ =	239.6	291.2	322.7	345.3	362.2	

*$p < .05$

Table B15

Final Segment Running Speeds (cm/sec) during Extinction after

Punishment or No Punishment in the Middle Segment

Four-day block				SP-ANP			
	35	45	49	32	38	44	50
1	105.2	90.4	148.3	45.1	25.0	55.3	72.0
2	23.0	77.3	146.6	58.7	69.2	21.8	69.9
3	18.5	47.9	117.9	4.1	23.8	43.8	47.6
4	43.8	112.5	152.5	4.1	4.1	56.0	51.7
5	51.7	127.1	149.6	4.1	4.1	39.4	41.2
6	38.3	100.7	86.8	4.1	4.1	61.8	29.8
1	129.8	135.6	204.2	86.3	124.5	112.9	74.6
2	65.2	138.6	200.2	92.5	83.1	120.3	85.9
3	71.1	102.2	198.6	4.1	4.1	100.0	77.5
4	63.2	136.2	185.0	4.1	4.1	111.2	80.8
5	78.7	135.6	190.6	4.1	4.1	107.8	84.7
6	83.9	145.6	185.0	4.1	4.1	109.0	48.2
				AP-SNP			
	33	39	43	47	36	40	46
1	142.6	67.4	99.3	152.9	110.9	44.4	137.2
2	141.9	81.6	98.2	145.6	117.3	23.1	115.1
3	4.1	38.3	107.0	73.4	88.2	4.1	45.8
4	4.1	81.5	127.1	127.3	138.9	4.1	115.1
5	4.1	4.1	124.5	129.8	139.8	4.1	130.3
6	4.1	4.1	108.9	132.9	127.3	4.1	63.0
1	117.5	65.4	101.7	151.0	125.2	68.6	134.9
2	92.0	78.2	97.4	160.5	115.5	33.2	152.9
3	4.1	84.7	99.1	118.0	121.9	4.1	104.9
4	4.1	48.2	113.6	156.5	139.8	4.1	132.9
5	4.1	4.1	111.8	145.2	154.0	4.1	135.6
6	4.1	4.1	120.8	148.9	122.8	4.1	65.6
				AS-PNP			
	31	37	41	51	34	42	48
1	139.8	39.2	59.6	79.6	71.3	101.8	129.1
2	130.3	4.1	12.5	63.8	53.6	93.6	112.8
3	59.7	4.1	4.1	41.7	28.5	94.4	108.7
4	119.7	4.1	4.1	43.8	74.8	95.7	115.5
5	132.9	4.1	4.1	4.1	64.9	98.5	125.8
6	118.0	4.1	4.1	4.1	68.2	103.5	86.3

Table B15, continued

1	148.9	84.3	121.8	128.0	101.8	101.8	169.4
2	160.8	4.1	96.8	84.2	51.5	93.6	152.9
3	125.3	4.1	4.1	123.8	28.5	94.4	149.6
4	138.6	4.1	4.1	85.6	74.8	95.7	152.5
5	149.6	4.1	4.1	4.1	64.9	98.5	152.9
6	156.5	4.1	4.1	4.1	68.2	103.5	132.9

Note. Speeds listed second for each subject are those on trials when shock was present in the middle segment.

Table B16

Three-way Analysis of Speeds through the Final Segment during Extinction

Source	SS	DF	MS	F
Between subjects	495507.99	20		
Treatment group	4402.50	2	2201.25	.08
Error	491105.49	18	27283.63	
Within subjects	234364.90	231		
Punishment	26173.21	1	26173.21	32.98**
Group X Punishment	9480.36	2	4740.18	5.97*
Error	14284.06	18	793.55	
Days	57134.63	5	11426.92	10.28**
Group X Days	3187.76	10	318.77	.28
Error	99960.25	90	1110.66	
Punishment X Days	2971.06	5	594.21	2.81*
Group X Punishment X Days	2153.84	10	215.38	1.01
Error	19019.67	90	211.32	

*$p < .05$
**$p < .001$

Table B17

Followup of Treatment Group by Punishment Interaction in the Final Segment: A Newman-Keuls Test

	2476	2710	3414	3534	3656	3977
2476		234*	938*	1058*	1180*	1501*
2710			704*	824*	946*	1267*
3414				120	242	563*
3534					122	443*
3656						321*
$q_{.95}(r,18)\sqrt{nMS_{error}}$ =	221.3	269.0	298.0	319.6	335.3	

*$\underline{p} < .05$

Table B18

Mean Weight (g) of Animals in each Group throughout the Experiment

Group	I[a]	E	T	1	2	3	4	5	6
SP-ANP									
32	230	209	219	228	230				
35	248	212	234	242	247	254	258	264	266
38	202	218	232	248	248				
44	268	214	227	244	256	264	268	274	279
45	239	200	219	230	236	246	251	256	258
49	282	242	249	253	255	261	263	266	266
50	240	205	212	220	230	233	235	240	243
AP-SNP									
33	225	198	216	221	224				
36	240	215	224	232	234	237	241	246	244
39	255	224	236	240	241	243	241		
40	214	193	210	220	228				
43	220	198	216	221	227	232	232	240	242
46	236	217	228	229	234	237	239	241	241
47	235	222	236	234	244	247	251	256	260

[a]I = initial weight, E = weight during exposure days, T = weight during training, numbered columns are blocks of 4 days during extinction.

Table B18, continued

AS-PNP									
31	240	220	235	242	244	244	250	256	256
34	243	206	220	229	235	241	244	252	252
37	268	238	256	266					
41	245	207	218	228	237				
42	236	203	228	248	250	251	252	258	263
48	238	216	228	238	244	250	250	256	256
51	245	214	225	238	244	254	256		

Table B19

Groups by Phases Analysis of Weights through Block 2 of Extinction

Source	SS	DF	MS	F
Between subjects	8572.952	20		
Treatment group	1149.738	2	574.869	1.39
Error	7423.214	18	412.400	
Within subjects	10472.000	63		
Phase	8803.142	3	2934.380	107.04*
Group X Phase	188.642	6	31.440	1.14
Error	1480.214	54	27.411	

*$p < .001$

Table B20

Groups by Phases Analysis of Weights for Blocks 3 and 4 of Extinction

Source	SS	DF	MS	F
Between subjects	2694.000	14		
Treatment group	927.800	2	463.900	3.15
Error	1766.200	12	147.183	
Within subjects	77.500	15		
Phase	45.633	1	45.633	19.69*
Group X Phase	4.066	2	2.033	.87
Error	27.800	12	2.316	

*$p < .001$

Table B21

Groups by Phases Analysis of Weights for Blocks 5 and 6 of Extinction

Source	SS	DF	MS	F
Between subjects	1825.500	11		
Treatment group	594.250	2	297.125	2.17
Error	1231.250	9	136.805	
Within subjects	33.000	12		
Phase	10.666	1	10.666	4.41*
Group X Phase	.583	2	.291	.12
Error	21.750	9	2.416	

*$p < .05$

Table B22

Fluid Consumption (ml) of Animals in each Group throughout the Four-day Blocks of the Experiment

Four-day block[a]	SP-ANP 32	35	38	44	45	49	50
E	14.0	17.0	13.0	12.0	15.5	10.5	14.0
T	19.5	19.5	20.5	18.5	20.5	22.5	18.5
1	20.5	24.5	24.0	20.0	24.5	20.0	20.5
2	19.5	20.5	23.5	22.0	22.5	24.0	20.0
3		25.0	24.0	20.5	20.5	22.5	21.0
4		22.5		20.0	22.5	25.0	19.0
5		27.5		21.0	22.0	19.5	19.0
6		19.0		19.5	20.0	22.0	21.0
E	18.5	20.5	17.5	16.5	19.0	14.5	15.0
T	20.0	23.0	23.0	19.5	23.5	20.5	15.5
1	16.5	20.5	24.0	20.0	23.0	20.0	17.5
2	19.0	25.0	24.5	22.0	23.0	21.0	18.5
3		21.0	25.5	22.0	25.0	22.0	19.0
4		24.0		22.0	23.5	18.5	19.5
5		22.5		22.5	24.5	18.5	18.0
6		25.0		23.5	25.5	20.5	19.5

[a]E = exposure days, T = shock-escape training days, numbered blocks are days of extinction.

Note. Amounts listed first for each subject are mean amounts of 3.17% ethanol solution consumed; those listed second are mean amounts of sugar water.

Table B22, continued

AP-SNP

	33	36	39	40	43	46	47
E	14.0	11.5	13.0	10.5	16.5	12.5	18.5
T	23.0	18.5	21.0	21.5	22.5	19.0	22.0
1	22.5	17.5	18.5	21.0	22.0	19.5	22.5
2	25.0	18.5	23.5	22.5	23.0	21.0	24.5
3		18.5	20.0		23.0	18.0	23.5
4		20.5	21.0		26.5	19.0	25.5
5		20.5			25.0	21.0	23.0
6		21.5			23.0	20.0	27.0
E	20.5	18.5	18.5	19.5	21.5	18.0	22.0
T	22.0	19.0	22.5	22.0	22.0	18.5	13.5
1	25.0	17.0	21.5	21.0	22.5	17.0	24.0
2	25.0	17.5	22.0	21.5	25.5	22.0	27.0
3		19.0	19.0		22.5	21.0	24.0
4		21.0	17.5		26.0	20.0	24.0
5		19.5			25.5	22.5	27.0
6		17.0			22.5	21.0	24.0

AS-PNP

	31	34	37	41	42	48	51
E	14.0	13.0	15.0	11.5	17.0	13.0	11.0
T	24.5	22.5	24.0	18.0	21.5	19.5	20.5
1	24.0	24.0	24.5	16.0	22.0	21.0	23.0
2	25.5	26.5		21.5	23.5	21.5	23.5
3	26.5	24.0			21.0	20.0	22.5
4	27.5	24.0			23.0	20.5	24.5
5	27.5	25.0			23.5	23.0	
6	25.0	25.0			23.0	21.0	
E	24.0	18.0	25.0	13.5	19.5	18.5	17.0
T	23.0	24.0	24.0	15.0	23.0	18.5	22.5
1	25.5	24.5	26.0	17.0	21.5	20.0	23.5
2	28.0	24.0		21.5	21.0	22.0	25.5
3	23.5	27.0			23.5	20.0	25.0
4	26.5	25.5			21.5	20.5	25.0
5	29.0	27.0			27.0	20.5	
6	25.0	25.5			22.0	22.5	

Table B23

Analysis of Fluid Consumption on Exposure Days

Source	SS	DF	MS	F
Between subjects	207.750	20		
Treatment group	11.607	2	5.803	.53
Error	196.142	18	10.896	
Within subjects	336.875	21		
Drinking solution	280.291	1	280.291	113.74*
Group X Solution	12.226	2	6.113	2.48
Error	44.357	18	2.464	

*$p < .001$

Table B24

Analysis of Fluid Consumption on Shock-Escape Training Days

Source	SS	DF	MS	F
Between subjects	191.119	20		
Treatment group	10.583	2	5.291	.52
Error	180.535	18	10.029	
Within subjects	69.500	21		
Drinking solution	.214	1	.214	.06
Group X Solution	6.535	2	3.267	.93
Error	62.750	18	3.486	

Table B25

Analysis of Fluid Consumption on Blocks 1 and 2 of Extinction

Source	SS	DF	MS	F
Between subjects	416.82	20		
Treatment group	37.17	2	18.58	.88
Error	379.64	18	21.09	
Within subjects	153.46	63	2.43	
Drinking solution	.01	1	.01	.00
Group X Solution	6.89	2	3.44	2.43
Error	25.46	18	1.41	
Blocks of days	36.53	1	36.53	17.68*
Group X Days	5.47	2	2.73	1.32
Error	37.19	18	2.06	

Table B25, continued

Solution X Days	.76	1	.76	.39
Group X Solution X Days	6.32	2	3.16	1.63
Error	34.78	18	1.93	

*p < .001

Table B26

Analysis of Fluid Consumption on Blocks 3 and 4 of Extinction

Source	SS	DF	MS	F
Between subjects	283.35	14		
Treatment group	52.10	2	26.05	1.35
Error	231.25	12	19.27	
Within subjects	101.87	45		
Drinking solution	.01	1	.01	.00
Group X Solution	1.30	2	.65	.17
Error	45.05	12	3.75	
Blocks of days	4.26	1	4.26	3.50
Group X Days	5.25	2	2.62	2.16
Error	14.60	12	1.21	
Solution X Days	2.81	1	2.81	1.22
Group X Solution X Days	.85	2	.42	.18
Error	27.70	12	2.30	

Table B27

Analysis of Fluid Consumption on Blocks 5 and 6 of Extinction

Source	SS	DF	MS	F
Between subjects	258.43	11		
Treatment group	73.01	2	36.50	1.77
Error	185.42	9	20.60	
Within subjects	135.81	36	3.77	
Drinking solution	1.17	1	1.17	.35
Group X Solution	1.96	2	.98	.29
Error	29.54	9	3.28	
Blocks of days	8.75	1	8.75	2.69
Group X Days	6.69	2	3.34	1.03
Error	29.23	9	3.24	

Table B27, continued

Solution X Days	.13	1	.13	.03
Group X Solution X Days	20.19	2	10.09	2.38
Error	38.10	9	4.23	

Table B28

Mean Ethanol Dosage (g/kg) for each Rat for each Block of Four Days throughout the Experiment

Group	Exposure	Training	1	2	3	4	5	6
SP-ANP								
32	1.68	2.22	2.20	2.10				
35	1.96	2.07	2.54	2.06	2.49	2.16	2.64	1.80
38	1.48	2.20	2.41	2.34	2.42			
44	1.40	2.03	2.04	2.16	1.94	1.86	1.91	1.75
45	1.88	2.32	2.68	2.42	2.07	2.23	2.15	1.93
49	1.08	2.24	2.00	2.36	2.16	2.38	1.84	2.04
50	1.72	2.15	2.32	2.18	2.26	2.02	1.97	2.16
AP-SNP								
33	1.72	2.64	2.55	2.78				
36	1.32	2.05	1.89	1.99	1.95	2.12	2.10	2.20
39	1.42	2.22	1.93	2.42	2.07	2.01		
40	1.33	2.62	2.38	2.46				
43	2.01	2.58	2.50	2.51	2.50	2.46	2.60	2.40
46	1.43	2.12	2.13	2.24	1.90	2.00	2.16	2.08
47	2.06	2.31	2.45	2.50	2.40	2.52	2.28	2.58
AS-PNP								
31	1.52	2.62	2.46	2.60	2.72	2.74	2.68	2.46
34	1.58	2.56	2.62	2.80	2.50	2.44	2.48	2.45
37	1.54	2.36	2.30					
41	1.36	2.06	1.76	2.26	.98			
42	2.08	2.37	2.22	2.34	2.11	2.27	2.28	2.18
48	1.49	2.16	2.10	2.22	2.09	2.10	2.23	2.05
51	1.26	2.28	2.40	2.43	2.20	2.40		

Table B29

Analysis of Variance for Ethanol Dosage through Block 2 of Extinction

Source	SS	DF	MS	F
Between subjects	3.516	20		
Treatment group	.163	2	.081	.43
Error	3.352	18	.186	

Table B29, continued

Within subjects	9.318	63		
Blocks of days	7.272	3	2.424	70.75*
Group X Days	.196	6	.032	.95
Error	1.850	54	.034	

*p <.001

Table B30

Analysis of Variance for Ethanol Dosage on Blocks 3 and 4 of Extinction

Source	SS	DF	MS	F
Between subjects	1.467	14		
Treatment group	.227	2	.113	1.09
Error	1.240	12	.103	
Within subjects	.187	15		
Blocks of days	.004	1	.004	.30
Group X Days	.022	2	.011	.83
Error	.160	12	.013	

Table B31

Analysis of Variance for Ethanol Dosage on Blocks 5 and 6 of Extinction

Source	SS	DF	MS	F
Between subjects	.913	11		
Treatment group	.369	2	.184	3.05
Error	.544	9	.060	
Within subjects	.534	12		
Blocks of days	.048	1	.048	.99
Group X Days	.044	2	.022	.45
Error	.441	9	.049	

Table B32

Speeds (cm/sec) through the Initial Segment on the First Trial each Day of Extinction after Consumption of 3.17% Ethanol or Sugar Water, Averaged for each Block of Four Days

Four-day block				SP-ANP			
	35	45	49	32	38	44	50
1	133.6	125.8	149.6	117.5	82.6	122.8	76.4
2	139.8	93.8	149.6	125.0	108.7	74.1	79.6
3	88.7	29.1	75.8	4.1	17.3	56.6	65.1
4	141.9	90.4	146.6	4.1	4.1	69.5	52.3
5	156.6	108.7	153.2	4.1	4.1	63.6	33.8
6	152.9	116.1	81.3	4.1	4.1	44.8	5.4
1	128.0	156.5	156.5	95.0	93.0	113.1	87.2
2	127.3	135.6	143.6	124.5	157.3	97.8	92.5
3	141.9	57.4	105.6	4.1	4.1	66.2	80.3
4	148.9	119.7	186.4	4.1	4.1	92.4	76.7
5	157.3	127.3	169.4	4.1	4.1	88.4	69.9
6	175.6	119.7	156.5	4.1	4.1	68.6	6.6
				AP-SNP			
	33	39	43	47	36	40	46
1	165.0	58.0	105.9	152.9	157.3	102.7	149.6
2	59.0	117.5	77.0	169.4	170.0	19.1	179.4
3	4.1	56.5	87.6	156.5	161.6	4.1	70.3
4	4.1	53.4	117.5	169.4	185.0	4.1	190.6
5	4.1	4.1	133.6	170.0	185.0	4.1	190.6
6	4.1	4.1	132.6	156.5	191.4	4.1	97.4
1	170.0	117.5	132.6	138.9	156.5	131.3	143.8
2	148.9	115.1	127.3	132.7	160.5	21.5	145.6
3	4.1	4.7	141.9	165.0	151.0	4.1	152.9
4	4.1	3.8	140.3	160.5	170.0	4.1	174.4
5	4.1	4.1	156.5	169.4	145.2	4.1	180.0
6	4.1	4.1	136.2	156.5	185.0	4.1	103.7
				AS-PNP			
	31	37	41	51	34	42	48
1	156.5	59.7	120.2	58.2	99.3	152.5	154.0
2	153.6	7.8	20.3	69.0	105.3	73.6	149.6
3	129.8	4.1	4.1	33.1	42.1	138.6	112.5

Table B32, continued

4	132.9	4.1	4.1	7.1	95.8	137.2	137.2
5	165.0	4.1	4.1	4.1	67.5	152.9	175.6
6	156.5	4.1	4.1	4.1	120.2	148.9	75.7
1	148.9	43.7	156.5	114.0	117.5	138.9	146.6
2	147.5	10.0	30.3	77.1	115.1	129.8	161.0
3	117.1	4.1	4.1	7.3	58.2	156.0	109.7
4	142.6	4.1	4.1	4.1	130.3	138.9	149.6
5	148.9	4.1	4.1	4.1	122.8	149.6	152.5
6	161.0	4.1	4.1	4.1	132.9	165.0	165.0

Note. First scores listed for each animal are speeds following consumption of ethanol; second scores are speeds after consumption of sugar water.

Table B33

Analysis of Speeds through the Initial Segment on the First Trial each Day of Extinction

Source	SS	DF	MS	F
Between subjects	658293.07	20		
Treatment group	12824.52	2	6412.26	.17
Error	645468.55	18	35859.36	
Within subjects	314376.79	231		
Drinking solution	5406.54	1	5406.54	11.80*
Group X Solution	953.15	2	476.57	1.04
Error	8240.42	18	457.80	
Blocks of days	86456.18	5	17291.23	8.85**
Group X Days	8527.29	10	852.72	.43
Error	175738.94	90	1952.65	
Solution X Days	490.18	5	98.03	.33
Group X Solution X Days	2030.35	10	203.03	.68
Error	26533.70	90	294.81	

*$p < .01$
**$p < .001$

APPENDIX C

Graphs of Speeds through the Initial, Middle, and Final Segments for All Groups of Experiment 2

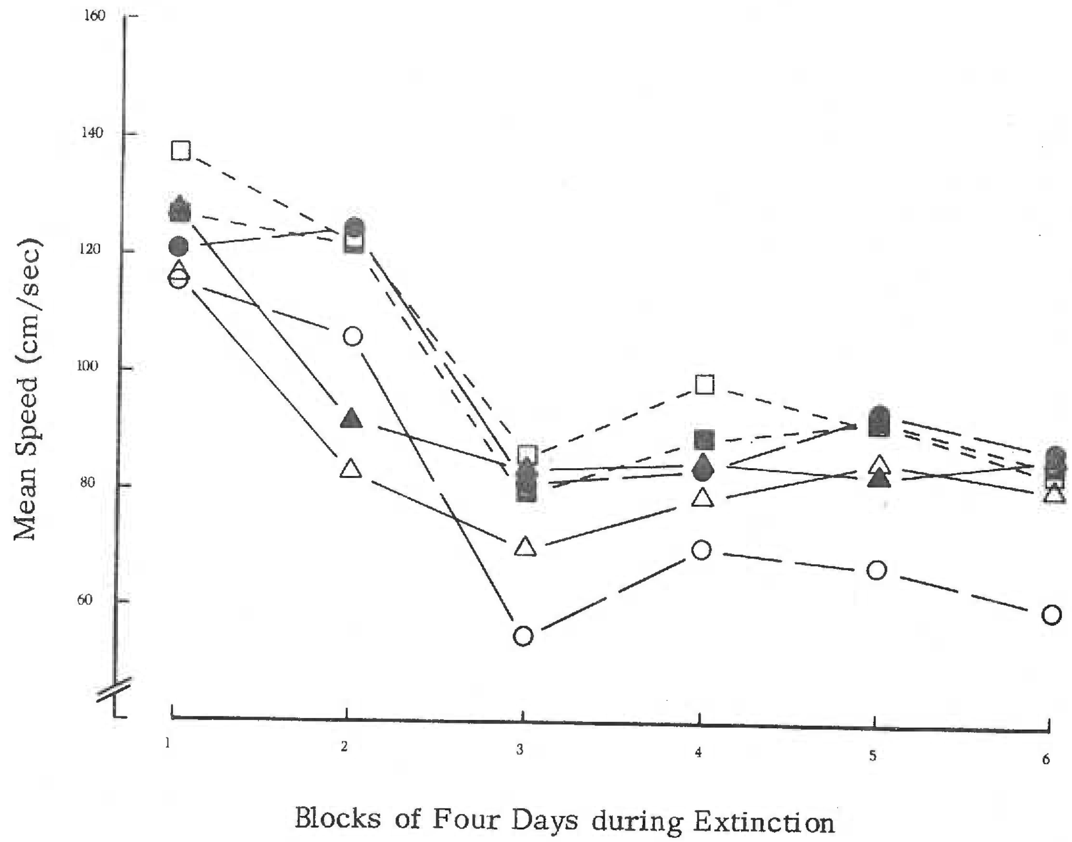

Figure C1. Initial segment running speeds during extinction. Filled symbols denote trials with shock-punishment impending in the middle segment; open symbols denote nonpunished trials. Drinking solutions were 3.17% ethanol and sugar water. △ = AS-PNP, □ = AP-SNP, ○ = SP-ANP.

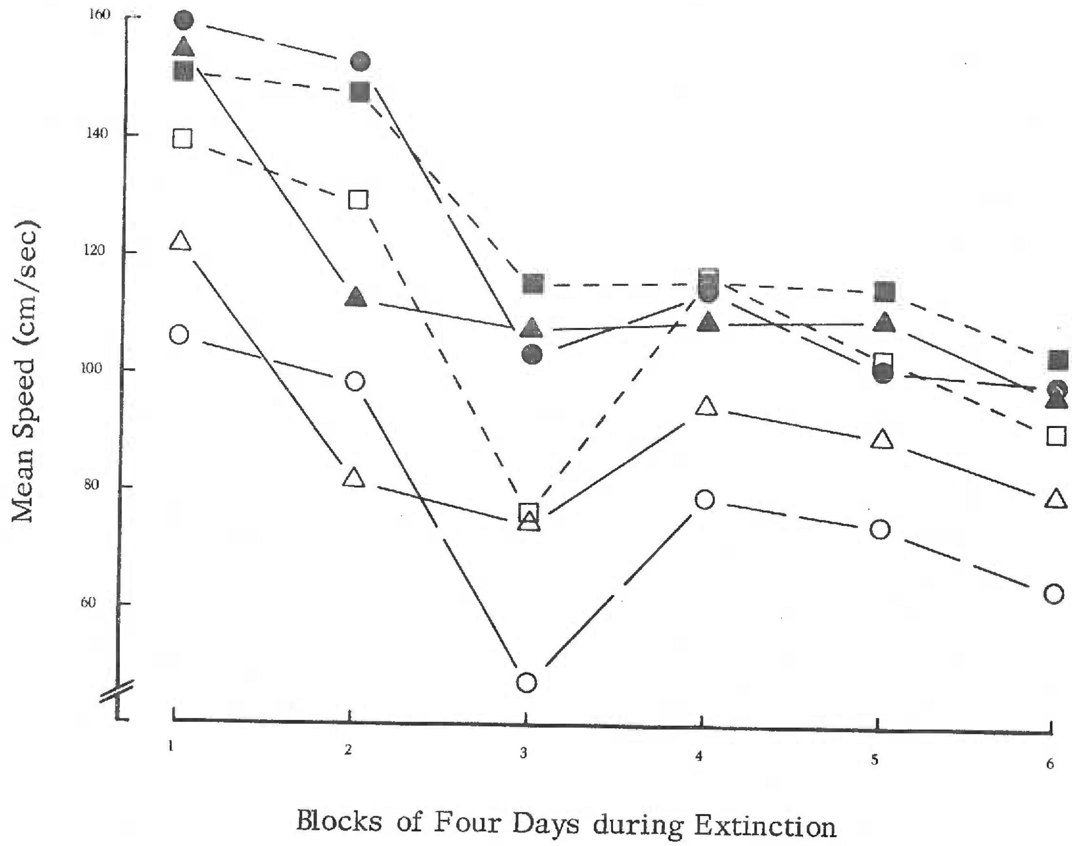

Figure C2. Extinction-phase running speeds through the middle segment, by treatment group and punishment contingency. Filled symbols indicate trials on which shock-punishment was delivered in this segment. Drinking solutions were 3.17% ethanol and sugar water. △ = AS-PNP, □ = AP-SNP, ○ = SP-ANP.

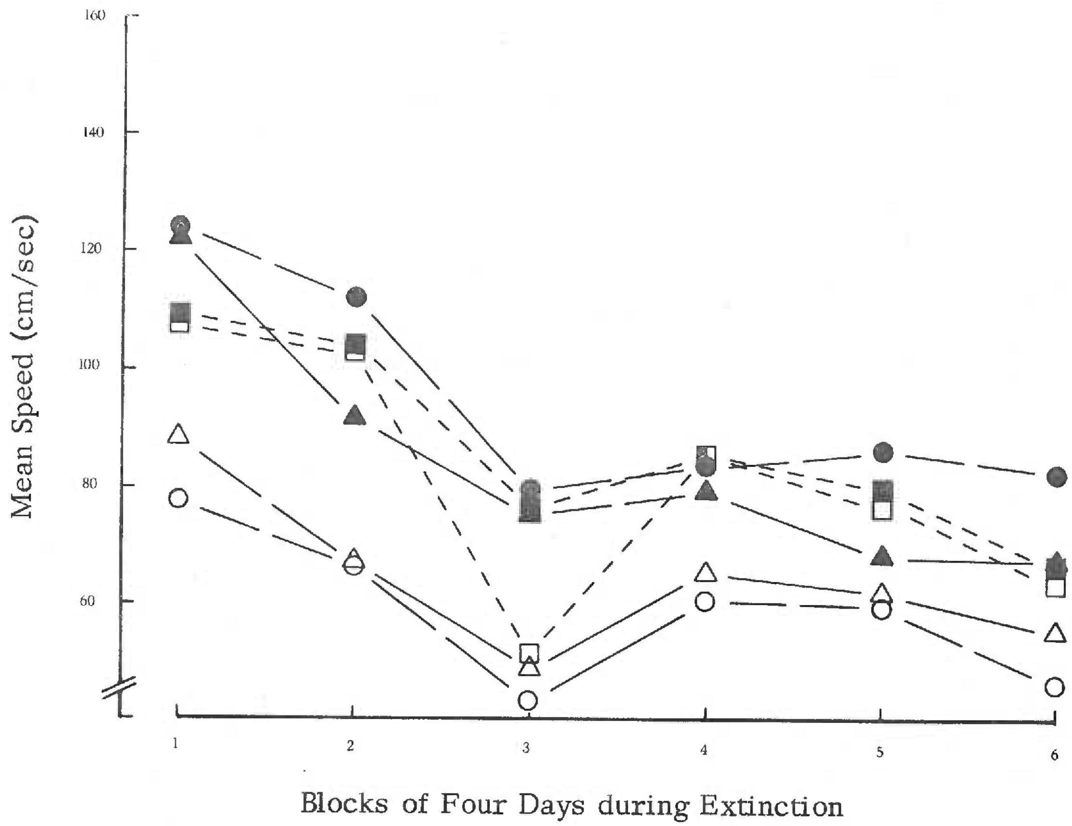

Figure C3. Final segment mean running speeds for each group after punishment and no punishment in the middle segment. Drinking solutions were sugar water and 3.17% ethanol in sugar water. △ = AS-PNP, □ = AP-SNP, ○ = SP-ANP.

APPENDIX D

Diagram of the Runway

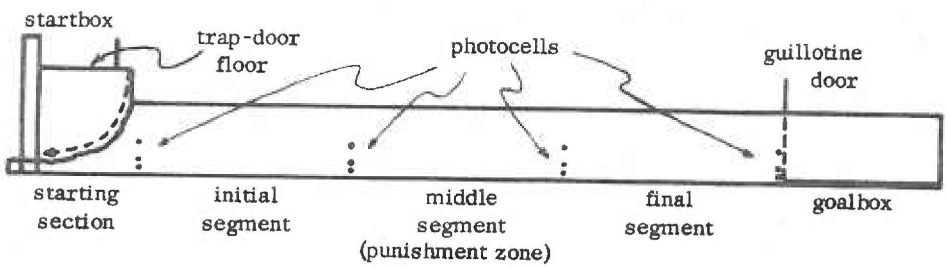

Figure D. Sideview diagram of the runway.