

A THERAPY TO ALLEVIATE LEARNED HELPLESSNESS

A Thesis

Presented to

the Faculty of the Department of Psychology

University of Houston

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

By

Barry J. Wepman

December, 1971

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I have uncovered for myself while working on this project the myth of the one-man investigation. Although only one name appears in authorship of this thesis, the job of accomplishing this work would not have been possible by my efforts alone. I, therefore, should like to preface this paper by expressing my thanks to those whose efforts have contributed to it.

I should like, first, to thank the members of my thesis committee for taking the time to read and criticize my efforts on this project. Dr. William Braud, who, as committee chairman, has plowed through every draft and has been a co-sufferer at each misstep; Dr. Richard Evans, who, throughout this project, has lent the support both financial and spiritual that eased my way; and Dr. Robert Hazelwood, who has taken time from his students and his work to read this arcane material from the outlands of psychology.

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ABSTRACT

Sixty-four rats were pretreated and then tested in a shock escape/avoidance shuttlebox. Forty-eight Ss were divided into 6 groups ($n = 8$) and given one of the following major pretreatments: confinement alone or confinement plus inescapable shock. These major pretreatments were followed by one of the following: escapable swimming, inescapable swimming, or nothing. Additionally, one group ($n = 8$) was given confinement only in an isolated room to control for odor cues and an eighth group ($n = 8$) was not pretreated at all. Eighteen to twenty-two hours following pretraining, all animals were given 20 trials in a shock escape/avoidance shuttlebox. Animals given preshock showed increased escape latencies and fewer escapes and avoidances than control or restrained Ss, and restrained Ss greater escape latencies but not fewer escapes and avoidances than control Ss. The swim conditions appeared to have no effect on later behavior, and the role of odor cues was indeterminant. The results were discussed in relation to several hypotheses, and it was concluded that the "learned helplessness" hypothesis (Maier, Seligman, and Solomon, 1969) was the most satisfactory in explaining the results.

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CHAPTER I

REVIEW OF THE LITERATURE

It is well established that exposure to inescapable electric shock can modify subsequent instrumentally conditioned behavior, but there appears to be conflict in the literature concerning the direction of the effect. That this is the case is of little surprise since the conditions set and the parameters investigated vary greatly from lab to lab. Thus, whereas some investigators report that preshock has a facilitating effect on learning of subsequent behaviors (Baron, Brookshire, and Littman, 1957) and some report little or no effect (DeToledo and Black, 1967), most, however, report that preshock (or prefear training) has a detrimental effect on parameters used to measure subsequent rate of acquisition of other behaviors (Overmier and Seligman, 1967; Seligman and Maier, 1967; Ragusa, Shemberg, and Rasbury, 1969; Cohen, 1970).

Before discussing the various findings, I should like to introduce the concept of learned helplessness briefly. Miller and Weiss (1969) tried to explain the decrement in later learning performance in animals given prior inescapable shock in this way: "Stopping effortful action might be immediately reinforced by escape from effort, while sitting might be further reinforced when shock went off." The reason

animals do not learn when they have made fortuitous correct responses (as will be reported later) is that many incorrect responses are correlated with termination of shock and this background noise is too pervasive for the animals to be able to gain any meaningful information. This explanation is invoked mainly to deal with data reported in several studies using dogs. Overmier and Seligman (1967) applied preshock to the paws of dogs suspended from a hammock to determine the effects of preshock on a shuttle avoidance/escape task. They found the greatest interference by presenting 64 6.0 ma inescapable shocks in 5 sec. applications with an average intertrial interval (ITI) of 90 sec. All dogs given this treatment became very passive when placed in a shuttlebox

shock 24 hours later. They tried neither to avoid nor escape and after the first trial or two, stopped yelping and stood quietly taking shock. A fortuitous correct response, which normally would have begun an associative process leading to learning of the task, had no effect on the dogs' behavior, and on future trials the dogs took shock as before. The time course of this effect, similarly reported by Overmier (1968), was such that if prefear training preceded the shuttlebox phase by more than 24 hours the helplessness effect dissipated.

Weiss, Kriekhaus, and Conte (1968) try to explain this interference by hypothesizing that incompatible motor responses, such as freezing, learned in pretraining could

interfere with those activities necessary for learning the escape behavior. Overmier and Seligman (1967) present evidence that this explanation is not sufficient to their results. They curarized dogs before giving them prefear training so that no motor activity was possible. On later testing in the shuttlebox, they found that these dogs behaved no differently than similarly shocked, non-curarized controls.

Seligman and Maier (1967) allowed some dogs to learn a response to escape unsignalled shock while suspended in a hammock. This consisted of pressing a panel on either side of them with their heads. Other Ss received an equal amount of shock, but had no control over its termination. They found that the Ss receiving escapable shock behaved like non-preshocked controls, but that the yoked animals exhibited significantly fewer correct responses.

This relationship may not be quite so simple as originally presented, however. Cohen (1970) reported that Ss given shock escapable only after a moderate latency period behave like those given inescapable shock even though they learned the escape from the harness quite well. It may be that the problem is not a dichotomous control-lack of control situation, but that perceived amount of control is an important consideration.

Bearing on this is a study to be discussed in greater detail later (Ragusa, Shemberg, and Rasbury, 1969) where the

authors reported that rats given either escapable or inescapable preshock responded more poorly on a later escape task than did non-shocked controls. The "escape" procedure in this instance enabled rats to delay shock for 10 sec., and the procedure was continued over 23½ hours. No data were supplied concerning the amount of shock any of the Ss received, so it may well be that this could also have been a case of not having provided an "escapable enough" situation.

Seligman and Maier (1967) also reported that dogs given pretraining in an escape situation and then given inescapable shock showed no decrement in performance when later tested in the shuttlebox.

As reported above, the preshock effect was found to dissipate if more than 24 hours intervened before avoidance trials. Seligman and Maier (1967) found, however, that if Ss are given avoidance/escape trials within 24 hours after preshock, the helplessness effect was still observable 168 hours later. Seligman and Groves (1970) found that by using inbred dogs reared from pups in individual cages minimizing Ss control of the environment, the helplessness effect was observable on first avoidance/escape exposure 72 hours after prefear training.

Seligman, Maier and Geer (1968) found that the helplessness effect could be eliminated by proper training. They reported that if Ss were dragged repeatedly across the shuttlebox removing them from the shock field to the "safe" side each

time, they would eventually "recover" from the preshock-caused passivity and would begin to respond normally. Maier, Seligman, and Solomon (1969) speculate that the S learns that "the conditional probability of shock termination, given the presence of any response, is equal to the conditional probability of shock termination, given the absence of that response." In other words, the animal learns that shock termination is independent of any response it can make, so it stops responding. The report by Seligman, Maier, and Geer (1968) seems to indicate that if the animal can be "made" to establish an association between responding and avoidance of shock, it will eventually learn to respond appropriately.

As reported above, however, much of the evidence concerning the effect of preshock does not support the learned helplessness theory. Ragusa, et al. (1969) reported that although inescapable preshock caused interference with later learning, so did escapable preshock. I have already indicated that an explanation for this finding could lie in the "escapability" of the preshock used. There were many other variations from the paradigms used in studies reporting helplessness in Ragusa, et al., which also might be examined. (1) Whereas the previously discussed studies used an intense shock over a short period of time (6.0 ma, 96 min. of training), Ragusa, et al., used a 2.0 ma shock for 23½ hours. It could be that even though tested 24 hours after preshock,

the Ss were exhausted from responding up to 6 times per minute for 23½ hours. (2) Seligman and Maier (1967) used a head-panel press and shuttlebox as their tasks whereas Ragusa, et al., used a paw-lever press and runway. Thus it could be that there was little transfer between the paw-press and the alley task, although other reports of the generality of the helplessness phenomenon (Braud, Wepman, and Russo, 1969; Padilla, Padilla, Ketterer, and Giacalone, 1970; Braud, Wepman, and Weatherly, 1971) cast doubt on this explanation. (3) Ragusa, et al., used grid shock whereas Seligman and Maier used electrodes taped to the Ss' paws. Not only did Ragusa, et al., use grid shock in their subsequent task, a procedure that may have caused a confounding with the effects of shock alone, but also, inescapable grid shock may be modifiable to an extent that the animal is given some control (Miller, 1961), thus eliminating differences between escape and yoked groups. (4) As mentioned above, a 10 sec. delay in preshock may not be "escapable" enough to provide the effect.

DeToledo and Black (1967) found results at odds with both sets already reported. They administered shocks of 1.3 ma to rats for a total of 30 sec., during a 10 minute period. Six minutes after preshock they placed the Ss in a one-way shuttle shock-escape situation and found that where later testing took place there were no differences in performance between them and nonshocked controls. Again, however, there

were many procedural differences evident here, and these findings are open to many criticisms if a comparison is made between their results and those indicating a detrimental effect of preshock.

Weiss, Kriekhaus, and Conte (1968) found that preshock produced a decrement in later avoidance responding, but they favor an interpretation based on the acquisition of competing motor responses during prefear training. Many of their data, however, lend themselves to a learned helplessness interpretation, and they base much of their argument on one experiment using a paradigm similar to the pre-inescapable shock avoidance training reported by Seligman and Maier (1967) for which a learned helplessness interpretation has been given. A second basis for their postulation rests on a study in which prefear Ss that responded poorly in an avoidance/escape shock situation were given extinction trials consisting of presentation of CS but no US presentation. After Ss had reached an extinction criterion they were retested with shock reintroduced. It appears to me that this is similar both to Seligman and Maier's (1967) study and the Seligman, et al. (1968) report of alleviation of helplessness. In the case of Seligman, et al., the dogs were forced across the barrier until the association with crossing became well established. In the Weiss, et al.,

(1968) report, the rats learned a response under decreasing fear until they eventually mastered it while the conditioned emotional response (CER) to the CS was not of an intensity to hinder responses but was still intense enough to motivate escape.

A study by Kurtz and Pearl (1960), in fact, indicated that although extinction of shock-produced prefear may indeed reduce the level of the acquired fear drive in Ss, some residuum remains that influences later behavior. They gave extinction trials to half of a group of rats given inescapable preshock. Both of these groups and a group of nonshocked controls were placed in a shock-escape situation, trained to a criterion and extinguished on this response. Both preshocked groups showed equal resistance to extinction and both showed greater resistance to extinction than did the control group. Thus, even though Weiss's rats might have lost a large component of their fear response, enough could have remained to have motivated them to learn the escape response. That the Ss in the Kurtz and Pearl study responded to the escape situation after inescapable preshock can be explained by the large amount of time that elapsed between preshock and later training.

Baron (1964) reported that preshock produced a generally suppressive effect in an altered environment. Mice given preshock and placed in an open field situation showed a

decrease in numbers of squares entered and an increase in inactivity periods when compared with a non-preshocked group.

Baron, Brookshire, and Littman (1957) reported that preshock facilitated learning of avoidance responses, but animals who exhibited this effect had been given preshock at 20 or 26 days of age and not tested on the avoidance task until adults (120-140 days). Clearly, the differences here are too marked for the results to produce much difficulty for the learned helplessness explanation, although they do pose certain interesting questions for future study.

Anderson, Cole, and McVaugh (1968) discuss their findings at some length in terms of the learned helplessness theory. They say that their rats squealed, jumped, and defecated vigorously when exposed to shock in contrast to the observations of dogs. However, Anderson, Cole, and McVaugh (Experiment 5) used a 6-day period intervening between preshock and testing, and their technique was at variance with that of Seligman and Maier (1967) and Overmier and Seligman (1967). In a private communication, K. Vanderslice reported that after using paw shock with rats suspended from a leather harness, Ss responded quite passively to later grid shock. Further, Anderson, Cole, and McVaugh (1968) also state that the preshock effect is not dependent on critical time periods. The studies they cite do, indeed, report different results, but in order for a

true determination to be made, a study using rats would have to be done using a paradigm very similar to that of Seligman and Maier (1967).

There is evidence accumulating to support the notion that the helplessness phenomenon has some situation and species generality. Braud, Wepman, and Russo (1969) trained mice in a shock-escape situation. One group of mice was given shock-escape training, a second group was yoked to the first, and a third group was given no shock. All animals were then placed in a water-escape situation and time to escape was noted. After five trials, both the escapable shock and the control groups' Ss were escaping more rapidly than they had at first. The yoked group escaped progressively less rapidly.

Padilla, Padilla, Ketterer, and Giacalone (1970), using goldfish, found that groups given inescapable preshocks later performed more poorly in a shock avoidance situation than did nonshocked controls. They found, too, that the interference effect could still be observed 48 hours after initial pre-shock but was gone from groups given avoidance training 72 hours after preshock. Braud, Wepman, and Weatherly (1971) found that goldfish removed from water for 1.5 minutes out of 2.5 for 75 trials over 3 days and restrained from flipping by the use of a damp towel placed over them performed much more poorly in a later shock escape/avoidance situation than either fish that was removed from water for the same amount

of time (but not restrained) or nontreated controls.

Pinkney (1967) found that performance of goldfish on a test task involving shock was inversely proportional to the number of fear conditioning trials given. Anderson and Paden (1966) found that rats given inescapable tumbling trauma showed slower running times in a straight alley in response to shock and stopped sooner than nontreated controls, yet the groups exhibited no differences using the same apparatus when the test task was appetitive.

Seward and Humphrey (1967) demonstrated a response decrement in cats following inescapable preshock on a later shock-escape task. Kahn (1951) demonstrated that mice defeated by trained, aggressive fighting mice of the same strain show increased and prolonged defensiveness when later put into a fighting situation. An interesting finding of this study was that amount of defensiveness was inversely proportional to age at exposure to defeat. He used mice 21, 35, and 60 days old at onset of "training" and found that the 21 day-old mice (even though exposed to fighting mice for $\frac{1}{2}$ the amount of time as the 35 and 60 day-old mice) later showed greater defensive reactivity, the 35 day-old mice were intermediate and the 60 day-old mice showed little increased defensiveness compared to untreated controls. These findings point up the importance of looking at the age of animals used in evaluating these studies.

Work has been done that indicates that humans are also susceptible to the helplessness effect. MacDonald (1946) found that college students learned a finger withdrawal avoidance response to shock more quickly than did preshocked students. Thornton and Jacobs (1971) found that Ss given inescapable preshocks of durations yoked to those given escapable preshocks learned to avoid and escape less well than those to whom they had been yoked or non-preshocked controls. An interesting finding was that Ss perceived variable intensity shock as more stressful than constant intensity shock even though both the upper limit and the mean of fixed shocks (set individually for each S) were higher than those of variable shock (lower limits were the same). This seems consistent with the findings of Seligman and Maier (1967) that predictability in shock parameters is less stressful to rats.

In addition to this behavioral evidence, there are data attributing physiological changes to inescapable shock and to confinement in mice (which may be analogous to the Braud, et al., goldfish situation). Brush and Levine (1966) found that after inescapable shock, later avoidance behavior in rats showed diminished number of avoidances when groups of animals were tested at .08, 1 and 4 hours postshock. They correlated this decrement in behavior with homeostatic recovery of normal levels of circulating steroids. However, 24 hours postshock the rats' performance again ascends, but

steroid level continues to decrease and, in fact, overshoots the normal plasma corticosterone level.

Rosenzweig (1966) in a study using confinement with mice in small hardware cloth compartments found that the fetuses of mice confined for periods during days 13 and 14 of pregnancy had more cleft palates than those of controls.

Weiss (1968) studied the relationship between weight loss and exposure to electric shock in rats. He divided rats into 3 groups: one group of rats which could avoid tail shock by learning to jump onto a platform when a tone sounded, a yoked group which received the same amount of shock as the first group but could not control it, and a nonshock control group. Animals in all three groups had been matched for weight. Body weight and food and water intake were measured at 16 and 24 hours after the 2.5-3.0 hour test session. At both the 16 and 24 hours posttest rats in the yoked group weighed significantly less than animals in the other two groups, and at 24 hours the yoked group consumed less food and water than either of the other groups. Weiss also found that rats given inescapable shock developed more numerous and more severe stomach ulcers than either nonshock controls or rats given escapable shock (to which rats in the first group were yoked).

In another study Weiss, Stone, and Harrell (1970) found that the brain norepinephrine (NE) level of yoked animals given inescapable shock was lower than that of

nons shock controls, and that animals allowed to learn an avoidance/escape response showed an elevated NE level.

One of the purposes of the proposed study will be to determine if a "therapy" consisting of mastery of an unrelated aversive escape task will reduce the interference of prior inescapable shock on a later shock-escape shuttlebox task. A positive finding would be consonant with the learned helplessness hypothesis and would be difficult to explain by many of the other theories of the mechanism of pre fear training.

Another question which can easily be investigated at the same time is that of the importance of olfactory cues in fear in the rat. Olfaction seems to be a very important sensory modality for rats, and one by which rats receive much information about specifics in the surrounding environment. It has been shown that odor substances from rats under stress can be differentiated by other colonies (Krames, Carr, and Bergman, 1969). Food odors can take on reinforcing properties (Long and Tapp, 1967), cat odors can be used to suppress running time in rats (Courtney, Reed, and Wasden, 1968), and odors have been shown to interfere with straight alley running performance (Ludvigson and Systma, 1967) in such a way that the effect seems to be analogous to the mechanism of an alarm pheromone (Gleason and Reynierce, 1969).

McHose and Ludvigson (1966) have attributed differential responding of groups of rats to similar reinforcers to odors

left by rats run previously that had different experiences in the same apparatus. McHose, Jacoby, and Mayer (1967) found that odor cues produced differences in resistance to extinction among groups of rats which were otherwise handled similarly.

It seems reasonable, therefore, to question the effect of olfactory cues left in an apparatus in which rats have been shocked in light of the fact that control rats are often confined in the apparatus used for shock and are termed non-treatment controls. A method of investigating this question is included in the design of the proposed study.

CHAPTER II

STATEMENT OF THE PROBLEM

There is a considerable amount of conflicting data and opinion about both the effect of inescapable preshock on subsequent aversive escape/avoidance behavior and the mechanism responsible for the effect. Baron, Brookshire, and Littman (1957) found that preshock facilitated later shock avoidance whereas DeToledo and Black (1967) found that preshock had no effect whatsoever. Of those who found an interference effect, some attribute it to the development of "competing motor responses" (Weiss, et al., 1968); others (Anderson, et al., 1968) attribute the effect to internal-cue mediational effects; and still others (Overmier and Seligman, 1967; Seligman and Maier, 1967) attribute the effect to "learned" helplessness.

Since the learned helplessness theory postulates absence of a coping response as the mechanism for a response decrement following inescapable shock (Maier, Seligman, and Solomon, 1969), a procedure which reinstates a coping response following shock should serve to eliminate a response decrement on the escape/avoidance test task. Braud, Wepman, and Russo (1969) and Braud, Wepman, and Weatherly (1971) found that inescapable shock and inescapable air-exposure tasks generalized to produce decrements in later

swim and shock situations, respectively, in two animal species (mice and goldfish). The procedure used by this study, then, will interpose a swim-escape task between inescapable and escapable shock procedures.

As an additional interposed situation, restraint will be used both in conjunction with inescapable preshock and alone as a control measure. This will serve the combined purpose of increasing the stressfulness of the pretreatment situation (Rosenzweig, 1966) when used in conjunction with shock and to control for the possibility of preshock's causing either competing motor responses or shock-based internal cue mediation, as have been hypothesized when shock has been used by itself.

To additionally isolate the factors responsible for changes in responding to the escapable shock task, it is important to add an "odor control" condition. This group will serve to help identify any inter-subject communication accomplished by means of pheromones or other chemical means (Gleason and Reynierse, 1969).

CHAPTER III

METHOD

Subjects

The Ss were 64 male albino rats obtained from Texas Inbred Mice Company, Houston, Texas. All animals were kept at least 14 days before the start of training and all animals were used within 35 days after arrival. Animals ranged from 250-350 grams when tested.

Apparatus

The apparatus used for giving inescapable shock was modeled after that used by Weiss (1968). It consisted of 5 in. x 2½ in. x 3 in. restraint cages made of ¼-in. hardware cloth supported by a wooden base. The insert was cut out of the floor so it, too, was only hardware cloth. An electrode was attached to Ss' tails and secured by means of air conditioning duct tape which was wrapped loosely below the electrode and clipped with a large alligator clip which was attached so that the jaws of the clip engaged a tab of tape and put no pressure on the tail. Illumination was provided by a 25 w. red light bulb, and the shock source was a variac transformer wired in series with a 10 K Ω fixed series resistor.

The swim-escape apparatus consisted of a glass aquarium, 30 in. x 12 in. x 15 in., filled with 55°F water to a depth of 15 in. When the tank was used for escape a 3 in. wide

hardware cloth ladder extended into the water from a wooden platform suspended across the top of the tank at one end. The ladder and platform were illuminated by a high intensity lamp in an otherwise darkened room. When the tank was used for yoked groups, it was similarly equipped but ladder and platform were removed.

The shuttlebox was a wooden box, 34 in. x 5 in. x 6 in., with one Plexiglas side. It contained a floor of steel rods through which 1.15 ma scrambled shock was delivered. A six w. white light at each end served as a CS and there was a 4 in. high styrofoam and hardware cloth electrified barrier separating the box into two equal chambers.

Procedure

Animals were housed singly 14-35 days before the onset of training. The Ss were assigned to eight groups, eight rats per group. Three groups (S groups) were given inescapable shock in the restraining cages. Three other groups (NS groups) were similarly restrained but not shocked. A seventh group (C group) was given no pretraining but was handled the days before testing. The eighth group (OC group) was confined in an apparatus similar to that used for the other groups but in a separate room from the others to eliminate any odors emitted by the S groups.

One subgroup from the S groups and one from the NS groups (S-SE and NS-SE, respectively) were given escapable swim training; subgroups from S and NS groups (S-SNE, NS-SNE) were

matched in swimming times with Ss from appropriate escape groups and given inescapable swim training; the last two subgroups from S and NS groups (S-NS, NS-NS) were returned to their home cages immediately after treatment. The OC group was also returned to home cages immediately after restraint. The control group (C) was removed from home cage the day before testing only to be handled.

Inescapable shock consisted of administration of 1.0 ma tail shock for a randomly determined 5 sec. period out of 90 sec. for 60 trials. The NS and OC animals had tail electrodes placed but no shock delivered.

Immediately following shock training or confinement appropriate animals were given water-escape training. The E placed animals at one end of the water tank, released them and noted the time until an escape was accomplished. An escape was completed when the S had all four legs on the platform above the tank. If animals did not escape after one minute, they were removed, dried, and placed back in the water after a five-minute interval. The Ss were run until they made five successive escapes of latencies less than 30 sec. If an animal did not reach criterion within 50 trials, it was discarded.

The swim-no escape (-SNE) subgroup animals were yoked to animals in appropriate swim-escape groups and given the same amount of immersion time as their partners but were not given the opportunity to escape.

Twenty-four hours after the original confinement, all Ss were given 20 trials in the escape/avoidance apparatus. All Ss were placed in the shuttlebox and given five minutes to adapt. The onset of the CS (light) began each trial and remained on until the trial was terminated. The CS-US interval was 10 sec. If an S moved to the other side of the box during this interval alone, it terminated the trial and no shock was given. Failure to move to the other side within the CS-US interval led to the onset of 1.15 ma shock which remained on until the S moved across the box or until 5 sec. had elapsed. The intertrial interval was 60 sec. Indices recorded were the number of avoidances, the number of escapes, and total amount of shock time.

CHAPTER IV

RESULTS

Data reported comprise number of avoidance responses, number of combined escape plus avoidance responses, number of intertrial responses, and latencies on the twenty shuttle-box trials (Appendix A). Since the number of intertrial responses was obviously negligible, those data were not analyzed. Avoidance responding likewise was limited and avoidance responses scattered among the groups, but since we were interested in coping responses, it was decided to retain the information provided by avoidance scores and to combine these with number of escape responses to make the data more amenable to analysis (Appendix A and Table 1). Comparisons were made using the Mann-Whitney U test (Siegel, 1956) unless otherwise indicated.

Table 2 (Appendix B) shows the comparisons made within major treatments between swim conditions. As can be seen, no differences are manifested among any of these groups, indicating that swim treatment ("therapy") was ineffective.

In light of the uniformity in results in testing between subtreatment groups within major treatments, it was decided to combine these groups and treat both shock and restraint groups as if they contained homogeneously treated animals for comparisons across major groups. As can be seen

TABLE 1
 MEDIAN AND SEMI-INTERQUARTILE RANGES OF COMBINED ESCAPES
 AVOIDANCES AND LATENCIES FOR MAJOR TREATMENT GROUPS
 AND SUBGROUPS COLLAPSED OVER TRIAL

Group	LATENCIES (in sec.)		ESCAPES AND AVOIDANCES	
	MDN	S.I.R.	MDN	S.I.R.
Restraint & Shock	40.8	6.2	18.2	1.5
Restraint only	35.2	4.8	19.1	1.0
Control	27.4	5.3	20.0	0
Swim-Escape	37.7	5.0	19.5	1.0
Swim-No Escape	37.7	5.7	18.5	0.8
No Swim	36.1	3.5	19.0	0.4

from Table 3 (Appendix B), there were significant differences on both escape and avoidance and latency measures between shock vs. control ($p < .002$, $p < .002$) and restraint only vs. control ($p < .02$, $p < .03$, respectively); there were significant differences on the latency dimension between shock vs. restraint ($p < .025$) and shock vs. odor control ($p < .05$). These differences are further illustrated by Figure 1 which indicates latencies over the testing phase in blocks of 4 trials. As can be seen for all but 2 points of the 15 plotted shock groups show the greatest latencies, control the smallest with restraint intermediate.

A comparison was made combining swim-escape groups and swim-no escape groups (Table 4- Appendix B); this comparison indicated no differences between these groups. This is further illustrated by Figure 2 which provides a breakdown of latencies over the testing phase in four-trial blocks for swim-escape, swim-no escape, and no-swim groups. None of these differences is significant at any point. The more general comparison of swim vs. no-swim (Table 4 - Appendix B) was likewise non-significant.

Analyses of individual groups vs. the control group (Table 5 - Appendix B) were significant for escapes and avoidances in the case of S-SNE vs. C, S-NS vs. C, and NS-NS vs. C ($p < .01$ in all cases) and tended toward significance in the cases of S-SE vs. C and NS-SE ($p = .06$). Latencies in the same comparison were significant in the cases of

FIGURE 1. MEAN LATENCIES OF MAJOR TREATMENT
GROUPS IN BLOCKS OF FOUR TRIALS.

FIGURE 1

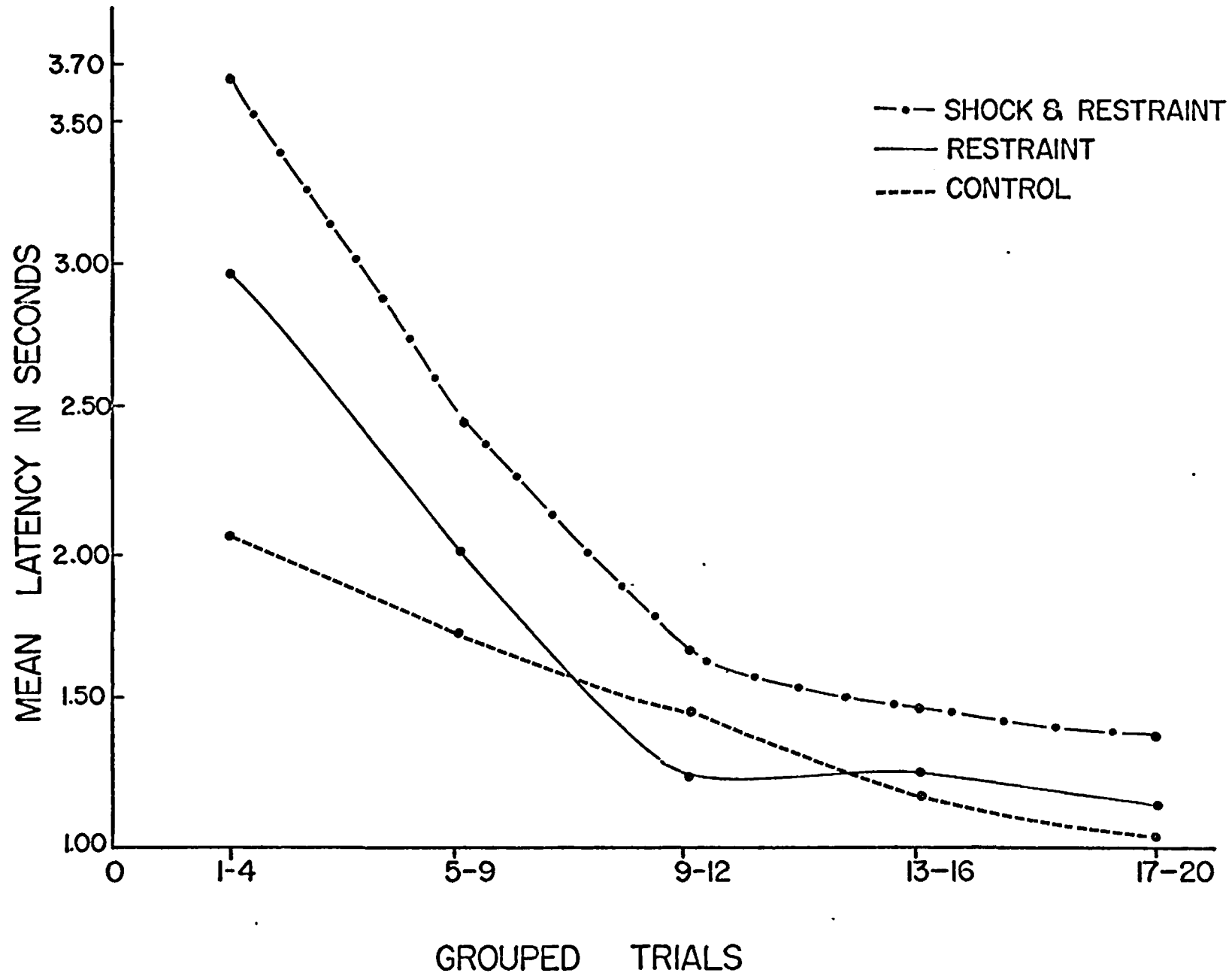
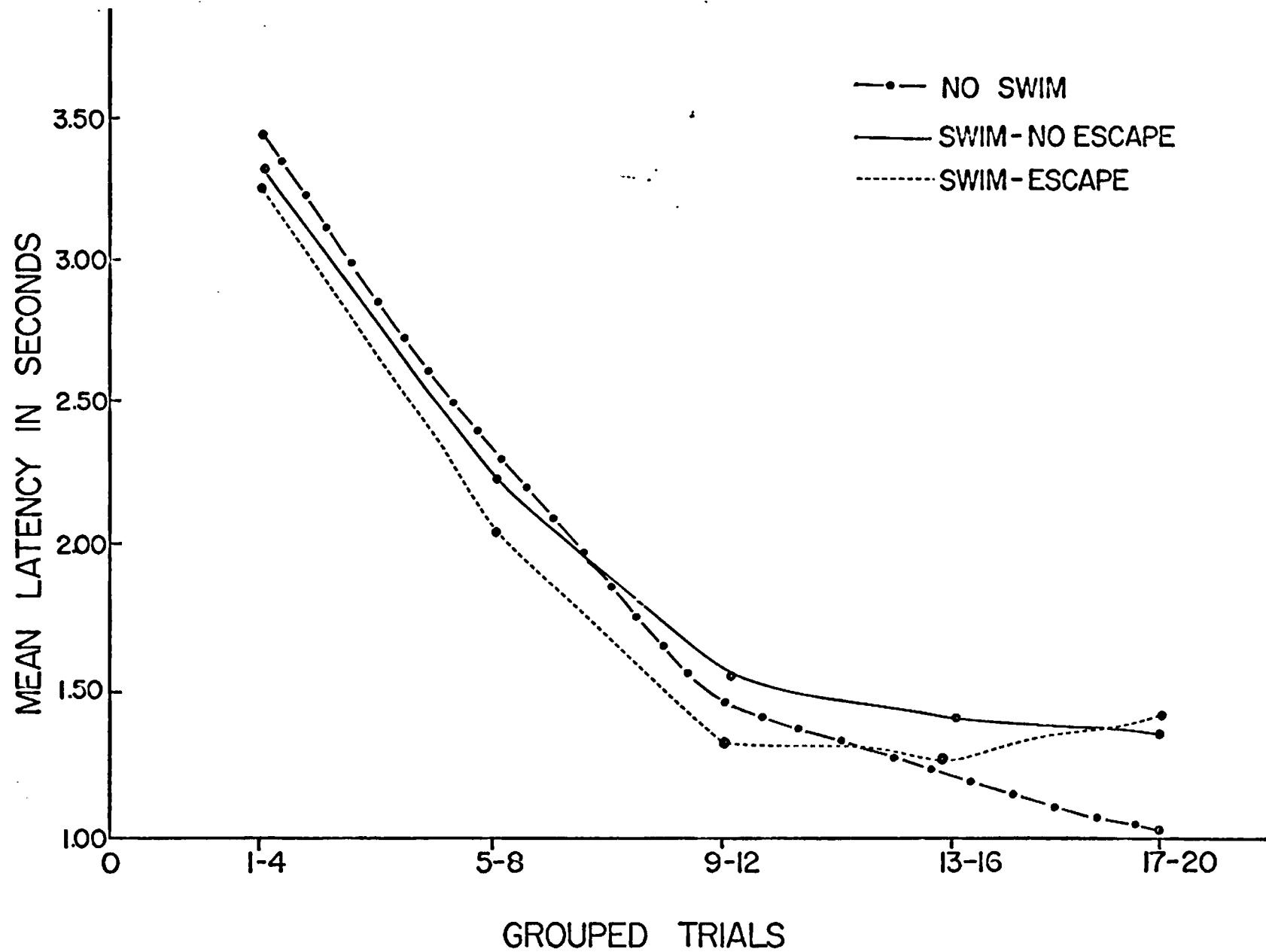


FIGURE 2. MEAN LATENCIES OF SUBTREATMENTS
 ("THERAPIES") IN BLOCKS OF
 FOUR TRIALS COLLAPSED ACROSS
 MAJOR TREATMENTS.

FIGURE 2

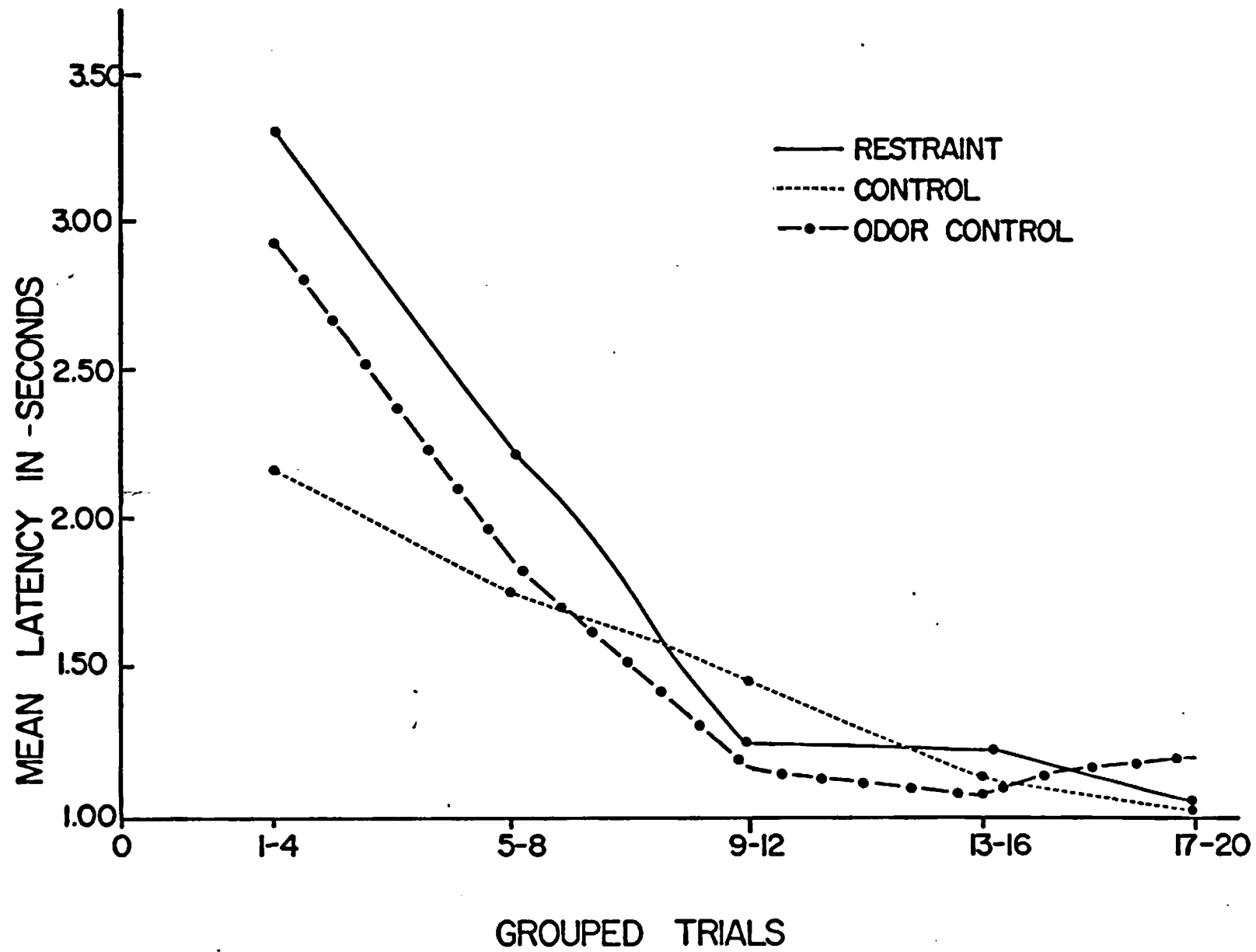


S-SE vs. C ($p = .004$, S-SNE vs. C ($p = .006$), S-NS vs. C ($p = .01$) and NS-NS vs. C ($p = .04$).

The OC group was not significantly different from any individual group where comparisons could be made (C, NS-NS, S-NS), but was significantly different from the combined shock group (Table 6 - Appendix B). And a further breakdown (Fig. 3) indicated no obvious trends.

Analyses done to evaluate the relationship between swimming and shuttlebox performance using the Spearman's rho (Siegel, 1956) also yielded no significant findings (Table 7 - Appendix B).

FIGURE 3. MEAN LATENCIES OF CONTROL VS. RESTRAINT
VS. ODOR CONTROL GROUPS IN
BLOCKS OF FOUR TRIALS.



CHAPTER V

DISCUSSION

There are several theories used by almost as many authors to explain the effects of preshock on later learning. The learned helplessness explanation appears adequate to handle those data reported by the original proponents of the theory (Overmier and Seligman, 1967; Seligman and Maier, 1967; Seligman, Maier and Geer, 1968), and seems also to bear directly on studies by other investigators (Braud, Wepman, and Russo, 1969; Braud, Wepman, and Weatherly, 1971; Padilla, et al., 1970; Thornton and Jacobs, 1971). Some investigators, however, have rejected it as not totally applicable to their results (Weiss, 1970; Weiss, et al., 1968; Ragusa, et al., 1969). However in the latter case many of the situations used to explore the preshock phenomenon were dissimilar enough from those used in the former cases to raise the question of whether the differences were purely methodological.

Weiss, et al. (1968) favor the competing motor response hypothesis to explain response decrements following preshock. It is difficult to reconcile this hypothesis with the present finding on either logical or observed grounds. Seligman (1970) reports that a slap on the hindquarters provides unsuitable negative reinforcement to teach a dog not to jump forward. Similarly it can be argued that tail

shock should impel rats forward, not provide reinforcement for "freezing" as Weiss's hypothesis would indicate. Further weight is lent the intuitive argument by considering that rats' tails are shaped and textured to be easily withdrawn from aversive situations, and in fact, it was noted during the course of the present study that the Ss would push forward as their tails were gripped for placement of tail electrodes--hardly a freezing response. Furthermore, during preshock Ss (far from freezing) would react quite strongly to administration of shock, moving as much as possible within the confines of their restraining cages. As a last argument, it is difficult to see how a freezing response would have been instated in the Ss who were merely confined and given no shock at all.

Anderson, Cole, and McVaugh (1968) say that preshock may have internal-cue mediational effects that might persist and interfere with later performance by increasing level of fear in preshocked Ss. Again the present data would seem to be less than compatible with this theory. Although this might explain the results of shock, it does not explain the response decrement caused by confinement alone (see below).

Similarly Kurtz and Walters (1962) suggested that even when behaving similarly on nonshock tasks, preshocked animals retain a residual performance difference when tested in situations using shock. This theory does nothing to explain the difference occurring between restraint and control

groups. It seems clear that in order to explain the present findings, a theory must be invoked that transcends simple aftereffects of shock to explain post shock response decrements, and addresses a more general mechanism lodged, perhaps cognitively, in aftereffects of stress in general.

The learned helplessness hypothesis appears to fit the data better than the other two theories. It provides a cognitive model for the major effects and also serves to explain the behavior of the Ss in the restraint cages. When Ss were first shocked, they reacted quite vigorously: biting, squealing, defecating and making violent escape movements. After about 40 shocks they would lie passively on their backs and emit only minimal vocalizations; yet all Ss seemed normal when removed from the cages.

The behavior the next day, however, was not at all what Seligman and Maier (1967) described for dogs. Far from standing passively and accepting shock, the Ss would squeal and defecate, seemingly similar in affect to what was described by Weiss, et al. (1968), but in contrast to the "freezing" described in the above article, they would run around the shuttlebox. The Ss in this experiment also learned the response much more rapidly and with more regularity than the dogs that were similarly treated (Seligman and Maier, 1967; Seligman, Maier, and Geer, 1968; Overmier and Seligman, 1967), and the difference appears so marked that it may be that the effect manifests itself

differently in rats (at least with shock) or may follow a different time course. Ragusa, et al. (1969) also found that preshock interfered with later shock escape performance, and he criticized the learned helplessness theory on the basis that escapable shock also induced interference. There was no comparable group in the present study, and it is possible that the performance of such a group would be useful.

On the other hand, all of the findings just mentioned stand in contrast to those of Baron, et al. (1957) where shocked animals escaped more rapidly than did nonshocked animals, although in the latter study animals were preshocked when young and tested several weeks later, and of DeToledo and Black (1967) who got no differences in performance between shocked and nonshocked rats. Comparison with this latter study is especially interesting because Ss were shocked in comparatively spacious boxes, and it may be possible that, in the present study, restraint was both necessary and sufficient to cause the decrement and that shock merely augmented the effect of confinement.

The effects of "therapy" seemed to be negligible. Much of the reason for this appeared to have been due to the nature of the task. It was hypothesized that the swim-escape situation would serve to alleviate the effects of preshock by reinstating a coping response in the Ss' repertoires. For this to have been effective a stressful

situation with a moderately difficult escape task was required. Escape from an ice water bath was selected as fulfilling these requirements and, additionally, as being dissimilar from both the preshock and the test situation. It was found, however, that when water temperature low enough to be highly stressful ($< 55^{\circ}\text{F}$) was used, the animals were incapable of climbing the ladder; conversely, when the water was warm enough to allow the animals the necessary response, the task was made very simple. This situation had two effects: First, the simplicity of the task allowed the swim-escape animals to learn the task very rapidly and the temperature reduced the stressfulness of the situation (Woods and Campbell, 1967), making the therapy much milder than originally planned. This combination of effects also served to keep the swim-non-escape Ss in relatively "non-stressful water" for only a very short period of time, thereby diminishing any effects that this additional stress might have had. It can be seen, therefore, that the case for generalized "therapy" is still open, and that it is necessary for a better suited situation to be used before the question can be settled.

The last hypothesis examined--that of the effects of odor cues on later behavior--was also not settled. While the odor control group differed significantly only from the shock group and seemingly resembled the restraint group very highly, these results are not conclusive. Mears, Hardy,

Gabrial, and Uphold, 1971) found that rat odor cues do not linger greatly on wooden surfaces, but when absorbent butcher paper is used the effects of residual odor cues are apparent. It may, therefore, be that the wooden cage bottoms in the restraining apparatus was not an efficacious vehicle for the retention of odor cues. With this consideration, it should be pointed out that although they did not reach significance, there were differences between control, odor control, and no swim restraint groups, with the control showing the least effect of pretreatment, the no swim restraint group showing most, and the odor control intermediate.

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APPENDIX A

MEDIANS AND SEMI-INTERQUARTILE RANGES OF ALL VARIABLES

TABLE 2

MDNS AND SEMI-INTERQUARTILE RANGES OF AVOIDANCE RESPONSES,
 COMBINED ESCAPES AND AVOIDANCES, INTERTRIAL RESPONSES,
 AND LATENCIES OF THE 8 TREATMENT GROUPS
 COLLAPSED OVER TRIALS

	AVOIDANCES		A & E		INTERTRIAL RESPONSES		LATENCIES	
	MDN	SIR	MDN	SIR	MDN	SIR	MDN	SIR
1	0	0	18.5	1.5	0	0	42.0	6.5
2	0	0	17.5	2.5	0	0	41.8	11.6
3	0	0	19.5	0.5	0	0	38.6	4.9
4	0	0	19.5	0.5	0	0	36.8	7.4
5	0	0.5	20.0	1.5	0	1.0	33.6	9.9
6	0	0	19.5	1.0	0	0	35.0	4.9
7	0	0	20.0	0.0	0	0	27.4	5.3
8	0	0.5	19.0	1.0	0	0	32.6	6.8

APPENDIX B

ANALYSIS OF FINDINGS

ANALYSIS OF FINDINGS

TABLE 3

ANALYSIS OF INDIVIDUAL TREATMENT SUBGROUPS (THERAPIES)

GROUPS	ESCAPES AND AVOIDANCES		LATENCIES	
	U	P	U	P
S-SE vs. S-SNE	42	>.50	30	.44
NS-SE vs. NS-SNE	25	.50	32	>.50
S-SE vs. NS-SNE	17.5	.16	17	.13
S-SNE vs. NS-SNE	24	.44	28	>.50
S-SE vs. S-NS	20	.23	32	>.50
S-SNE vs. S-NS	20	.23	23	.40
NS-SE vs. NS-NS	29	>.50	22	.32
NS-SNE vs. NS-NS	30	>.50	33	>.50

TABLE 4
ANALYSIS OF ESCAPE-AVOIDANCE RESPONSES OF
MAJOR TREATMENT GROUPS

	ESCAPES AND AVOIDANCES		LATENCIES	
GROUPS	U	P	U	P
Shock vs. Restraint	221	.2 < p < .1	153	<.025 (n=48)
Shock vs. Control	28	<.002	21	<.002 (n=32)
Restraint vs. Control	36	<.02	40	.03 (n=32)
O.C. vs. Restraint	82	n.s.	87	n.s. (n=32)
O.C. vs. Control	16	<.05	20	n.s. (n=16)
O.C. vs. Shock	68	n.s.	46	<.05 (n=32)

TABLE 5
ANALYSIS OF "THERAPY" CONDITION DATA
COLLAPSED OVER MAJOR TREATMENTS

	ESCAPE AND AVOIDANCE		LATENCIES	
GROUPS	U	P	U	P
Swim-Escape vs. Swim-No Escape	323	>.1	116	>.1
Swim vs. No-Swim	163	>.1	142	>.1

TABLE 6

ANALYSIS OF INDIVIDUAL GROUP DATA
VS. CONTROL GROUP DATA

	ESCAPE AND AVOIDANCE		LATENCIES	
GROUP	U	P	U	P
S-SE vs. C	12	.06	6	.004
S-SNE vs. C	8	.01	7	.006
S-NS vs. C	8	.01	8	.01
NS-SE vs. C	16	.10	20	.23
NS-SNE vs. C	12	.06	20	.23
NS-NS vs. C	8	.01	10	.04
OC vs. C	16	.10	20	.23

TABLE 7

COMPARISON OF ODOR CONTROL GROUP
WITH OTHER NON-SWIM GROUPS

GROUP	ESCAPES AND AVOIDANCES		LATENCIES	
	U	P	U	P
S-NS vs. OC	32	>.50	20	.23
NS-NS vs. OC	31	>.50	28	>.50
C vs. OC	16	.10	20	.23

TABLE 8

CORRELATION BETWEEN SWIM PERFORMANCE AND
 ESCAPE-AVOIDANCE PERFORMANCE
 FOR SWIM-ESCAPE GROUPS

	ESCAPE-AVOIDANCE AND SWIM TRIALS TO CRITERION		LATENCIES AND SWIMMING TIME	
GROUP	rho	p	rho	p
S-SE	.05	>.20	.67	> .05
NS-SE	.49	>.05	0	> .50