THE EFFECT OF
PRIOR 'FEAR' AND 'ESCAPE' TRAINING
ON
AVOIDANCE LEARNING

BY

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PRETRAINING AND AVOIDANCE LEARNING

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PREFACE

In order to study any form of behavior scientifically, it is necessary to study the factors that control it and that therefore are responsible for any changes that occur within it. Some known factors are situational conditions and stimuli, physiological states, and reinforcement contingencies that influence the type of behavior studied.

The specific type of behavior studied in this thesis is avoidance behavior where one of the main controlling factors is physiologically painful stimulation the cessation of which constitutes a negative reinforcer. A review of the literature relevant to the problem in general will be presented before the specific problem, the results and their discussion.

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CHAPTER I

Review of Avoidance Learning Theories

The review of avoidance learning theories makes the study of any one problem in avoidance behavior clear. Such a review usually starts with Pavlov's principles of classical conditioning. Pavlov had noted that a certain response can be elicited by a stimulus that previously did not do so, as a result of repeated presentations of this stimulus (CS) followed by the stimulus (US) that originally evoked that response. The repeated presentation of the unconditioned stimulus after the conditioned stimulus results in better conditioning than when theCS follows the US as judged by the frequency of conditioned responses (CR). It is said that the unconditioned stimulus reinforces the conditioned stimulus in evoking the conditioned response (1). Pavlov, however, paradoxically cites an example of the conditioned response in the defense reflex, where weaker animals save themselves from carnivorous ones by hiding or running on the sight or sound of the stronger animals (2). He does not explain how the weaker animal learns to run at the sound of the other animal. According to his principles of conditioning an unconditioned stimulus, in this case possibly lethal

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1. Pavlov, I. Conditioned Reflexes. (Anrep, G. V. Translator), Oxford, Oxford University Press, 1927

2. ibid. p. 14

must be present every time the animal runs away (CR) at the sight or sound (CS) of the stronger animal. The alternative possibility of the sight or sound of the larger animal acting as a noxious stimulus is not considered.

The applicability of Pavlov's principles of classical conditioning to experimentally arranged aversive situations, where the US, a noxious stimulus in the form of an electric shock followed the CS, is in doubt. According to Solomon and Brush (3), Schlosberg, and Hilden seperately found that learning does occur under conditions where the US was an electric shock that was inescapable, that is, always followed the CS independently of Ss behavior. They also found that learning was the same in another situation where conditions were similar except that the shock was escapable through the performance of a certain response.

Hunter, according to Solomon and Brush (4), was among the first to report superior learning under conditions where the US (shock) could be avoided over conditions where it was inevitable. The CR was running to another part of a runway and 39 out of 43 rats in the escapable shock group met the learning criterion of 10 successive CRs, in contrast to 4 out of 30 in the non-escapable shock group.

In 1938, Brogden, Lippman, and Culler made a similar study comparing the effect of inevitable shock and avoidable shock. Two groups of guinea pigs were studied. In one group, Ss were shocked

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3. Solomon, R. L. & Brush, E. S. Experimentally derived conceptions of anxiety and aversion, in Jones, M. R. Nebraska Symposium on Motivation. Lincoln, University of Nebraska Press, 1956.

4. ibid

whether they ran or not to the sound of a buzzer, as in classical conditioning. In the second group, Ss were allowed to avoid the shock by running to the sound of a buzzer, and were shocked only if they failed to respond. The results were similar to Hunter's and learning reached a much higher level of performance in the second group indicating that learning was dependent on the avoidance of the shock (US), even though the reinforcement, in the sense used by Pavlov, was omitted (5).

Hull (6) the exponent of drive reduction theory of reinforcement, interpreted the avoidance situation according to his theoretical framework in contrast to the classical conditioning view of Pavlov. His interpretation was that after repeated presentation of the CS followed by the US which is not terminated until the CR occurs the CR, the "conditioned defense reaction" is established through its association with the cessation of pain. This constitutes the reinforcement in drive reduction terms. But once the CR is established and the organism is successfully avoiding the US, there is no occasion for the reinforcement to occur, and extinction of the CR begins. Then, however, the US is presented again and the CR is relearned and so on with consecutive cycles of learning and extinction, of avoidance and injury. Hull thought that this was biologically a non-adaptive process and considered it a paradox.

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5. Hilgard, E. R. & Marquis, D. Conditioning and Learning. New York, Appleton Century, 1940.

6. Hull, C. Principles of behavior. New York, Appleton-Century Crofts, 1943.

Miller (7) held that the reinforcement of the avoidance response lies in the reduction of the secondary drive of fear elicited by the conditioned stimulus. Evidence is drawn from his widely cited experiment in which he used a white and black compartment box where rats were shocked (US) in the white compartment and allowed to escape by running (CR) to the black compartment (8). After repeated trials, the Ss when put in the white compartment (its cues acting as CS) without being shocked would run to the black box. Furthermore they learned a new response, turning of a wheel that unlocked the door, in order to escape the white compartment cues that were presumably fear producing. Fear is interpreted therefore as being learned as a response to previously neutral cues and is held to act as a drive that can motivate learning. Under the above conditions, escape from shock is presumed to be a primary reward, and escape from the fear evoking cues is also rewarding as it reduces an acquired drive.

Further support for Miller's hypothesis comes from studies by May (9) and Brown and Jacobs (10). May trained rats first to escape shock in the Miller box and then confined them in the middle

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7. Miller, N. E. Learnable drives and rewards. In S. S. Stevens (ed.) <u>Handbook of Experimental Psychology</u>, New York, Wiley, 1950.

8. <u>ibid.</u>

9. May, M. A. Experimentally acquired drives, <u>J. exp. Psychol.</u>, 1948, <u>38</u>, 66-77.

10. Brown, J. S. & Jacobs, A. The role of fear in the motivation and acquisition of responses, <u>J. exp. Psychol.</u>, 1949, <u>39</u>, 747-759.

and presented a buzzer paired with shock. On test trials they were found superior in learning the correct response (crossing to the next compartment) to control groups that had training with buzzer alone, shock alone, or the two but never paired together. This was interpreted as due to the reinforcement of the response by the reduction of the acquired drive of fear.

Brown and Jacobs (11) eliminated the possibility of the correct response being learned through the reduction of an acquired drive of frustration and not fear. On the learning trials in Miller's and May's experiments, the running response was blocked by closing of the door between the two compartments. The prevention of a previously learned response from occuring may result in frustration. To eliminate this possibility Brown and Jacobs made the correct avoidance response, a hurdle jump, different from the escape response on training trials. The results indicate that groups that were trained with a paired CS and US, learned the new response while the controls pre-trained with buzzer or shock alone did not. This also is interpreted as due to the reinforcement of the response by the reduction of fear which is a learned acquired drive. The interpretation is in line with that of Miller.

In 1948, Sheffield (12) repeated the Brogden, Lippman and

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11. ibid

12. Sheffield, F. D. Avoidance training and the contiguity principle. J. comp. physiol. Psychol., 1948, 41, 165-177.

Culler experiment and found that unavoidable shock often evoked responses that were incompatible with the chosen CR (running). Successive avoidance of shock led to extinction of the CR but as the US was presented again, the CR was relearned. This latter finding is in line with Hull's formulation. However, Sheffield's interpretation is different. He points out that the omission of the noxious stimulus cannot be the reinforcing agent in the above situation or its successive absence would not result in extinction. He considers his findings on avoidance conditioning consistent with the contiguity theory of learning.

Mowrer's (13) two factor theory of learning makes use however of both contingiuty principles as well as effect theory principles in understanding avoidance learning. Emotional reactions such as fear are acquired on the basis of classical conditioning.

Mowrer and Miller differ in view on the way in which this fear is acquired or conditioned. Mowrer (14)(15) argues that the CS acquires fear arousing properties because it is paired with the onset of the noxious stimulus, that is, the onset of the painful experience.

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13. Mowrer, O. H. Learning Theory and Personality Dynamics, New York, Ronald Press, 1950

14. Mowrer, O. H., & Solomon, L. N. Contiguity vs. drive reduction in conditioned fear. The proximity and abruptness of drive reduction. Amer. J. Psychol., 1954, 67, 15-25.

15. Mowrer, O. H. & Aiken, E. G. Contiguity vs. drive reduction in conditioned fear, temporal variations in conditioned and unconditioned stimulus. Amer. J. Psychol., 1954, 67, 26-38.

and not its termination as Miller (16) argues. Miller's argument is that the CS acquires this capacity as it is paired with the termination of the US, this termination of the painful stimulus being drive reducing. Results of studies made by Mowrer and Solomon (17) and Mowrer and Aiken (18) where the two conditiones were examined experimentally are in Mowrer's favor since more effective fear conditions resulted from pairing CS with onset of US and not its termination. This they postulated as due to drive induction as opposed to drive reduction.

According to Mowrer (19) what happens in the avoidance situation is that when the CS is presented followed by the noxious stimulus US, emotional reactions to the noxious stimulus occur. After repeated presentation, through classical conditioning, the emotional reactions become CRs that are evoked by the CS. However, skeletal responses are learned instrumentally and as the chosen CR or avoidance response terminates both the US and the CS in the standard avoidance situation, it is reinforced by fear reduction which is rewarding to the organism. In this way the avoidance response is learned.

An experiment by Gibson (20) on the effect of inevitable shock administered to goats supports the two factor theory according to her interpretation. The avoidable shock group showed better learning of the avoidance response than did the inevitable shock

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16. Miller, op.cit.
17. Mowrer & Solomon, op.cit.
18. Mowrer & Aiken, op.cit.
19. Mowrer, op.cit.
20. Gibson, E. I. The role of shock in reinforcement. J. comp. physiol. Psychol., 1952, 45, 18-30.

group. Gibson proposed a two-factor theory for the unavoidable shock situation. In this situation, the shock instigates an emotional emergency reaction, but also inhibits this reaction in order to give way after many trials to a defensive motor reaction. This double function of the shock gives a picture of general trial and error. No evidence to support the Pavlovian view that shock acts to reinforce a CR was found.

Solomon and Wynne (21) also hold to the same theoretical viewpoint of avoidance learning as does Mowrer, as a result of their own experimental investigation which tends to confirm a two factor theory. They added however the theoretical principle of "anxiety conservation" which is in contrast with Sheffield's view of extinction. The main concept is that the avoidance response to the CS when learned has a short latency, shorter in fact than the time needed to elicit the classically conditioned anxiety reaction. As such the avoidance response "prevents the CS from arousing anxiety reactions thereby conserving conditioned anxiety reactions from extinction (22)."

There are, however, approaches to avoidance behavior that depend solely on reinforcement principles of instrumental learning and do not require the principles of classical conditioning in explaining the acquisition of the avoidance response. Such approaches do not agree

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21. Solomon, R. L. & Wynne, L. C. Traumatic avoidance learning: the principles of anxiety conservation and partial irreversibility. Psychol. Rev., 1954, 61, 353-385.

22. ibid. p. 382

that the reinforcement lies in the reduction of an acquired fear or anxiety elicited by the CS. Skinner (23) for example, notes that after repeated presentation of the CS followed by the US the CS becomes a conditioned negative reinforcer and any response that terminates this CS is strengthened through operant conditioning. He predicts the avoidance learning curve to have a gradual rise and a slight fall which will rise again just as Hull (24) and Sheffield (25) had noted. His interpretation is that as successful avoidance response are made repeatedly without any reinforcement they extinguish except that the US is presented again.

Schoenfeld according to Keehn (26) also holds that the reinforcement of the avoidance response comes from the termination of a stimulus which has acquired aversive properties; but he also points to another way in which the avoidance response is learned: As the avoidance response is never punished, that is, never followed by shock, while all other responses are, it becomes the least aversive

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23. Skinner, B. F. Science and Human Behavior. New York, Macmillan, 1953.

24. Hull, op. cit.

25. Sheffield, op. cit.

26. Keehn, J. D. The effect of a warning signal on unrestricted avoidance behavior. Brit. J. Psychol. (in press).

reaction of the organism's behavior. Thus this response is not directly reinforced but indirectly as all other responses made in that situation are punished and not repeated.

Sidman (27) (28) did experimental research within the previously mentioned theoretical framework of Schoenfeld, and he was able to establish and maintain avoidance behavior without the use of a warning signal where the reinforcement is the delay of shock for a certain interval of time whenever the avoidance response occurs.

Mowrer and Keehn (29) point out that intertrial avoidance responses occur progressively less often in a fixed trial interval situation as they are not reinforced. However, they occur progressively more often in a situation where they delay the next trial, as they are reinforced by this delay.

Sidman (30) also found that the response which delays the shock for a longer time will be learned better and used more often, thus supporting Schoenfeld's hypothesis. Later Sidman (31) studied the properties of a warning signal in avoidance behavior. He found

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27. Sidman, M. Two temporal parameters of the maintenance of avoidance behavior by white rats. J. comp. physiol. Psychol., 1953, 46, 253-261.

28. Sidman, M. Delayed punishment effects mediated by competing behavior. J. comp. physiol. Psychol., 1954, 47, 145-147.

29. Mowrer, O. H. & Keehn, J. D. How are inter-trial avoidance responses reinforced, Psychol. Rev., 1958, 65, 209-221.

30. Sidman, op. cit.

31. Sidman, M. Some properties of the warning stimulus in avoidance behavior. J. comp. physiol. Psychol., 1955, 48, 444-450.

that the avoidance response occurs more frequently when a signal is present in the experimental situation than when it is absent. His interpretation is that in the absence of the signal, intertrial responses can compete successfully with the avoidance response, for the signal acts as a discriminative stimulus in an operant situation where the consequences of the avoidance response determine its function. The temporal relation between the two stimuli, CS and US, is not the important thing, in contrast with what the holders of the classical view would say.

A study by Keehn (32) on the effect of a warning signal on avoidance behavior confirms Sidman's interpretation concerning the discriminative properties of the signal. He found a greater number of responses occuring during theCS-US interval than before the signal, that is, in the inter-trial interval. The rationale runs as follows: if the signal, CS, had acquired aversive properties through its paired presentation with the shock, more responses would have occurred before the onset of the signal to postpone both the signal and the shock. This refutes the interpretation which holds that the signal acquires aversive properties.

Thus according to Sidman (33) and Keehn (34), the signal or CS becomes a discriminative stimulus in an operant conditioning situation,

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32. Keehn, op.cit

33. Sidman, M. Conditioned reinforcing and aversive stimuli in an avoidance situation. Trans. N.Y. Acad. Sci., 1957, 19, 534-544.

34. Keehn, op.cit.

rather than a fear arousing stimulus as held by Mowrer (35) and Miller (36).

To summarize, we find in reviewing the field of avoidance behavior three main theoretical views supported by various experimental evidence. On the one hand there is the classical view of avoidance behavior where according to the principles of classical conditioning, the signal comes to elicit the response that was previously evoked by the noxious stimulus. On the other hand, there is the view that the signal acts as an S^D in an operant situation, setting the occasion for the correct response to occur at a time when it will be reinforced by elimination of the following noxious stimulus. Between these two views, there is the view that uses both principles, those of classical conditioning and reinforcement theory to account for avoidance behavior by positing an acquired fear drive.

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35. Mowrer, op.cit.

36. Miller, op.cit.

CHAPTER II

Learning of the Avoidance Response

The avoidance response in the classical view of avoidance learning as held by Bugelski (37) is nothing more than the escape response classically conditioned to the CS. In his own words, "regardless of the possible effect on the animal of getting away from pain, we note here again the antedating tendency of the response in its moving forward in time so that eventually it occurs prior to the shock" (38). This view implies that it is necessary for the escape response and the avoidance response to be the same. However, studies (39)(40)(41) where the escape response was different from the avoidance response have been reported.

Brown and Jacobs (42) pretrained their animals on an escape response and then made the avoidance response different from it. The avoidance response was still learned.

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37. Bugelski, B. R. The Psychology of Learning. New York, Holt, 1956

38. ibid, p. 61

39. Brown & Jacobs, op. cit.

40. Mowrer, op. cit.

41. Keehn, J. D. On the non-classical nature of avoidance behavior. Amer. J. Psychol., (in press)

42. Brown & Jacobs, op. cit.

Mowrer and Lamoreaux (43) were able to establish avoidance behavior in a group of rats where the response that terminated the US, shock, was jumping (or running) and the response that put off the CS, light, and avoided the shock was running (or jumping). Thus they point out that the escape and the avoidance responses can be different and need not be the same. But the nearer the avoidance response is to the escape response in topography, the better it is learned. These findings, Mowrer interprets as being in line with the two factor theory of learning where the reinforcement of the avoidance response comes from its reduction of the fear elicited by the CS, as well as its elimination of the painful US.

Another study by Keehn (44) shows that postponing (avoidance) responses, running forward in an activity wheel, that postpone shock onset for a fixed interval of time, could be established though they were different from and even incompatible with escape from shock responses, turning about in the cage. Keehn, however, does not offer an explanation though he points that the results definitely refute the classical view. Keehn suggests that the results maybe interpreted either according to Mowrer's fear reduction theory or Schoenfeld's view where the avoidance response occurs because all other responses have been punished by shock.

There has been increasing evidence, however, indicating that

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43. Mowrer, <u>op. cit</u>.

44. Keehn, <u>op.cit</u>.

avoidance behavior is operant and that the CS in the avoidance situation does not act as a fear arousing stimulus, but as a discriminative stimulus (45)(46). If, then, avoidance behavior is considered operant behavior, the shaping of the avoidance response becomes important in any avoidance training procedure. This can be done in different ways. One way is to give Ss a number of pre-training trials where other initial reactions to shock that are incompatible with the chosen avoidance response are eliminated. Where the avoidance response is the same as the escape response, this pre-training may take the form of continuous trial shocks that are terminated only when the escape response occurs. With repeated trials, the escape response is learned, and its latency decreases.

Few studies have investigated the effect of such pre-training, and in these the importance of pre-training lay in its effect both on emotionality and avoidance learning in the adult animal. Such studies were made by Chevalier and Levine (47), Levine and Chevalier and Korchin (48), Baron, Broakshire and Littman, reported by Ader (49)

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45. Sidman, op. cit.

46. Keehn, op. cit.

47. Chevalier, J. A. & Levine, S. The effects of shock and handling in infancy on adult avoidance learning. Amer. Psychol., 1955, 10, 432.

48. Levine, S., Chevalier, J. A. & Korchin, S. J. The effects of early shock and handling on later avoidance learning. J. pers., 1956, 24, 475-493.

49. Ader, R. The effects of early experience on subsequent emotionality and resistance to stress, Psychol. Monog., 1959, 73, 1-31

and Stanely and Monkman (50). As the main purpose of these studies has been to investigate the effects of early experience, mainly painful experiences, in infancy on adult behavior, there was always a big period of time between pre-training and the avoidance learning tests.

Chevalier and Levine (51) and Levine, Chevalier and Korchin (52) delivered shock to a group of mice during their first twenty days of life. No shock was delivered during this period to another group, and a third group was never handled. At 60 days of age, all three groups were given avoidance training. Results indicate that the no shock group made significantly fewer total errors than did the shock group. The ignored group was inferior to the shock group. Two hypothesis to account for the results were suggested (53). The poorer performance of the shock group was attributed to a disruption in infancy of the discriminative ability of the organism; or to a heightened level of anxiety drive, both due to painful stimulation in infancy.

Ader (54) criticizes these interpretations as the ignored group were inferior to the shock group although they never experienced stress or pain in infancy.

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50. Stanely, W. C. & Monkman, J. A. A test for specific and general behavioral effects of infantile stimulation with shock in themouse. _J. abnorm. soc. Psychol._, 1956, _53_, 19-22.

51. Chevalier & Levine, _op. cit_

52. Levine, Chevalier, & Korchin, _op. cit_

53. _ibid_

54. Ader, _op. cit._

The results of a study by Baron, Broakshire & Littman reported by Ader (55) are inconsistent with those of Chevalier and Levine, as they indicated that the effect of electric shock presented alone, not only in infancy but any time prior to the learning situation leads to superior performance in avoidance situations.

The results obtained by Stanely and Monkman (56) also are inconsistent with those of Levine and Chevalier. They pre-trained three groups in infancy. One group had shock that could be terminated by escape. Another group had shock fixed for a period of time and no escape possible. A third group had no shock. In adulthood, all three groups were given avoidance training. There were no significant differences found on the emotionality test, between the three groups. The group that had the early experience with escapable shock was superior to the others. The authors suggest that the superiority of the shock escapable group was due to positive transfer effects.

The results of the Stanely and Monkman study, though not interpreted as such, support the hypothesis that shaping of the escape response through pre-training where shock termination is contingent on a certain response providing escape facilities avoidance learning, although there was a long period of time between the pre-training and the avoidance training. Such pre-training was superior to pre-training where the shock comes at fixed intervals and is not escapable no matter

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55. ibid

56. Stanely and Monkman, op.cit.

what the animal does.

Problem and Experimental Design.

Consider the two most prominent views of avoidance learning, that of Mowrer (57) on the one hand, where the avoidance response is learned both because it provides escape from shock and a reduction of fear aroused by the CS, and the view held by Sidman (58) and Keehn (59) on the other hand, where avoidance behavior is considered operant and the CS as an S^D. These two interpretations can be compared if two groups of animals are pretrained differently and compared on avoidance training afterwards.

The design of such an experiment can consist of one group with trials where the CS is always paired with a fixed US in a classical conditioning fashion that permits, according to Mowrer, a fear reaction to be elicited by the CS. Another group pre-trained on an escape procedure where the shock is presented at every trial without a signal but could be terminated when the animal performs a certain response. These two groups can then be put on an avoidance training procedure where the CS is presented followed by shock after a short interval of time unless the animal performs the specific avoidance response which would be the same as the escape response.

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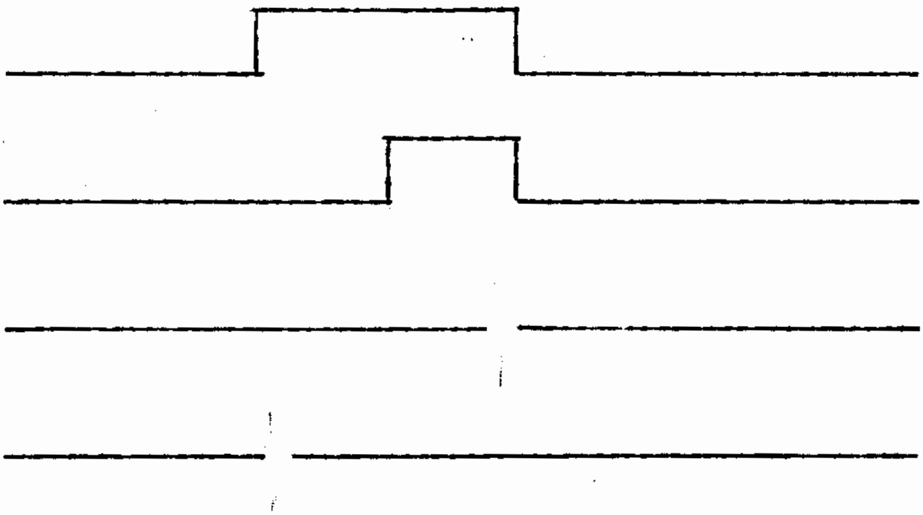
57. Mowrer, op.cit.

58. Sidman, op.cit.

59. Keehn, op.cit.



According to exponents of the fear reduction hypothesis, the first group should be superior in learning the avoidance response. This group is presented with a signal CS which as a result of repeated presentation with shock US comes to elicit the emotional reaction of fear. Any response that reduces this fear is reinforced.

A third group can be given avoidance training only, where the CS and the US will be paired, and at the same time, escape is permitted; that is conditions of both hypothesis are met in this group, CS - US - US - Response. This is the most standard procedure in avoidance training where a signal is used, and as such can be used as a control group when performance is to be judged.

CHAPTER III

Method

1. <u>Subjects</u>:

The Ss were 30 male albino rats from a German colony supplied by Versuchstierzuchterei - Brunger, Western Germany. Their ages varied from 90 - 120 days at the time of the experiment.

Two rats were kept in a seperate cage and had free access to food and water at all times.

The Ss were randomly assigned to three groups with 10 subjects in each.

2. <u>Apparatus</u>:

The apparatus consisted of an unpainted Mowrer-Miller (60) shuttlebox with a glass top. Its dimensions were: Length, 48 cms., width, 17 cms. and height, 28 cms. A 1 cm. thick wooden partition in the center of the box, made it into two compartments with an opening 8 x 7 cms. between them.

The floor of the shuttlebox consisted of 32 bronze rods, 1/3 cm. thick, placed 1.5 cms. apart center to center. The rods were electrically wired to deliver shock (120 v, 200,000 ohms series resistance) and controlled by a key that would deliver the shock to either compartment.

At the top of each compartment protruding from the side was a bulb (70 v, 15 w). Each bulb could be put on seperately.

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60. Mowrer, <u>op. cit.</u>

E could watch Ss behavior from a mirror fixed above the box in a darkened room where the whole apparatus was found.

The time was recorded with hand stop watches.

3. Procedure:

All Ss were handled for one minute and adapted for 10 minutes, one day before the training started. The adaptation procedure consisted of putting each S in the shuttlebox where it was free to move in the two compartments. The lights were turned on randomely for five times during the ten minutes' period. If S crossed from one compartment to the other in response to the light, S was eliminated.

Ss were randomly assigned to three groups with different training procedure. The groups were (1) the avoidance trained group, from hereon referred to as A.T group; (2) the fear pre-trained group, from hereon referred to as F.T group; (3) the escape pre-trained group, from hereon referred to as E.T group.

The A.T group:

The door between the Right and the Left compartments was kept open. S was put in the Right compartment where 55 secs. later the light (CS) came on for 5 secs. at the end of which a shock (US) was delivered. The shock was terminated when S crossed over to the next compartment and all four feet were off the live grid. The light was terminated at the same time as the shock thus ending the first escape trial. The same procedure was followed in the next compartment and so on. The inter-trial interval was scheduled randomly at 50, 60, 70 secs., with a mean of 1 minute.

If S crossed to the next compartment in the 5 secs. period when the light was on, it was not shocked and the trial was considered an avoidance trial.

As there was no block between the two compartments, S could cross freely between trials (in the absence of the CS). Each of such crosses was recorded as an inter-trial response.

Each S was given 10 trials per day. E recorded whether each trial was an escape or an avoidance trial. E also recorded inter-trial responses, as well as response latencies.

This procedure was continued till S made eight avoidance responses in any one day.

The F.T group

Each S was locked alternately in the left and right compartment of the apparatus for 4 successive days and "fear" trained as follows: The light signal (CS) was turned on after 55 secs. for a period of 5 secs. It was followed by an electric shock (US) delivered through the grid floor in the same way as for the avoidance group. After 2 secs. both the light and the shock were put off, thus ending the trial. There were 10 trials per day. Inter-trial intervals averaged one minute and were presented in the order 60, 50, 70 secs.

On the fifth day, the Ss in this group were put on avoidance training (same procedure as A.T) where Ss could both escape or avoid the shock. Avoidance training continued until an S made 8 avoidance responses in one day.

E.T group:

Ss in this group also had four days of pre-training but "escape" pre-training where every S each day was put in each compartment of the apparatus alternately, with no block between the compartments. 60 secs. later, a shock was delivered through whicever grid the animal happened to be on and was terminated by S running over to the other compartment through the opening. Training continued for the same number of trials with the same spacing as for the other groups.

E recorded escape latencies, and if S crossed over before the end of any trial, E recorded an inter-trial response.

On the fifth day, avoidance training began (same as A.T group) and continued until each S made 8 avoidances per day as in the case of the other groups.

Of the original 30 Ss, 4 were discarded for different reasons after they were assigned to the 3 groups. One in the E.T group was discarded as he "froze" to the shock and would not move from the grid floor no matter how long the shock was kept on. In the A group three were discarded: Two were discarded because they responded correctly to the light signal alone on the first trial after the adaptation period and before any shock was delivered. The third in this group was eliminated because he had 10 days of avoidance training and was still making very few avoidance responses, however, when a buzzer was introduced with the light signal he reached criterion in 13 days. The fact that he did not learn the avoidance response at first was attributed to his inability to notice the light.

CHAPTER IV

Results

Of the 30 Ss, 4 were discarded for reasons mentioned in Chapter 3, leaving 10 Ss in F.T group, 9 in E.T group, and 7 in the avoidance group. The results obtained from these Ss were as follows:

1. On Number of days to reach criterion.

To find the effect of the two different kinds of pre-training, on avoidance training, the mean number of days of avoidance training to reach a criterion of eight avoidances per day, was determined for each group. The A.T group had a mean of 7.7 days, the F.T group, 3.5 days, and the E.T group, 3.4 days.

An analysis of variance on days of avoidance training to reach criterion for the three groups is summarized in Table 1. As the F ratio was significant at the 0.005 level, the significance of the difference between the means of the groups or the number of days to reach criterion was determined by the t-test (see Table 2).

Source of Variance	M.S	Df	F	P
Between Groups	45.9	2	F = 7.5	.005
Within groups	6.1	23	F = 6.73	0.005

Table 1. Analysis of variance for the three groups, A.T, F.T, E.T, on the number of avoidance training days to reach criterion.

The difference between the means of groups F.T and E.T was not significant, indicating that the difference in the pre-training procedure had no differential effect on avoidance training with this particular criterion. However, there was a significant difference between the means of the A.T group and each of the other groups, showing that the period of pre-training had a positive effect on decreasing the number of days to reach criterion.

If, however, the total number of days is considered; four days of pre-training plus days of training for groups E.T and F.T, this difference between each and A.T disappears and the means become respectively 7.7 for A.T, 7.5 for F.T, and 7.4 for E.T.

GROUPS		N	MEAN	t	P
F.T vs E.T	Fear pretrained	10	3.5	0.15	N.S.
	Escape pretrained	9	3.4		
	DIFFERENCE		0.1		
A.T vs E.T	Avoidance trained	7	7.7	2.92	0.02
	Escape pretrained	9	3.4		
	DIFFERENCE		3.3		
A.T vs F.T	Avoidance trained	7	7.7	3.00	0.01
	Fear pretrained	10	3.5		
	DIFFERENCE		3.2		

Table 2. Means and t-Tests' values of the number of avoidance training days to reach criterion for groups A.T, F.T, and E.T respectively.

2. <u>Number of trials from first avoidance trial to the last trial.</u>

As the length of the period of pre-training, four days, was chosen arbitrarily, the above findings of the total number of days where no differences at all were found, may be attributed to this arbitrary choice. Therefore, a second measure was applied to the data. Once the first avoidance response occurs, the three groups irrespective of the number of escape trials can be equated on the basis of this point. The three groups can be compared on the number of trials from the first avoidance trial to the last trial. The t-test was used to determine the significance of differences between the means of the three groups (see Table 3). There was again no significant differences between E.T and F.T groups, but a significant difference

GROUPS		N	MEAN	t	P
F.T vs E.T	Fear pre-trained	10	25.5	0.48	N.S.
	Escape pre-trained	9	28.3		
	DIFFERENCE		2.8		
A.T vs F.T	Avoidance trained	7	58.2	2.44	0.05
	Fear pre-trained	10	25.5		
	DIFFERENCE		32.7		
A.T vs F.T	Avoidance trained	7	58.2	2.15	0.05
	Fear pre-trained	9	28.3		
	DIFFERENCE		29.9		

Table 3. The means, t-values, and P's of the trials from the first avoidance trial to the last trial for groups A.T, F.T, and E.T

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	DIFFERENCE		29.9		

Table 3. The means, t-values, and P's of the trials from the first avoidance trial to the last trial for groups A.T, F.T, and E.T

between A.T and F.T beyond the 0.05 level. The difference between A.T and E.T was significant at the 0.05 level. These results are consistent with those first obtained on the number of days to reach criterion, where the difference between the mean of the A.T and E.T group was found to be significant beyond 0.02 level, and the difference between A.T and F.T significant beyond 0.01 level.

3. <u>The First avoidance response.</u>

The number of trials it takes the animal to make the first avoidance response, reflects the effect of training prior to this point.

The mean trial of the first avoidance response was 19.0 for the A.T group, 9.5 for F.T group, and 6.1 for E.T group. An analysis of variance yielded a significant F ratio beyond the 0.001 level as shown in Table 4. Thus the difference between the means of the three groups on the first avoidance trial was determined by the t-test.

Source of Variance	M.S.	df	F	P
Between Groups	838.1	2	F = 51.4	0.001
Within Groups	16.3	23		

Table 4. Analysis of Variance for the three groups A.T, F.T, and E.T on the first avoidance trial.

Though E.T had the smallest mean (see Table 5) the difference between the means of the F.T and E.T groups was not significant. However, the difference between the mean of E.T and that of A.T was significant at the 0.01 level. The mean of the F.T was smaller than that of the A.T group, and the difference is significant at the 0.05 level. These results show the effect of pre-training on the occurrence of the first avoidance trial indicating that with pre-training the first avoidance response occurs earlier in the avoidance training than when there is no pre-training.

GROUP		N	MEAN	t	P
F.T. vs E.T	Fear pretrained	10	9.5	1.11	N.S.
	Escape pre-trained	9	6.1		
	DIFFERENCE		3.4		
A.T vs F.T	Avoidance trained	7	19.0	2.17	0.05
	Fear pre-trained	10	9.5		
	DIFFERENCE		9.5		
A.T vs E.T	Avoidance trained	7	19.0	3.55	0.01
	Escape pre-trained	9	6.1		
	DIFFERENCE		12.9		

Table 5. Means, t-values, and p's of the first avoidance trial for the three groups A.T, F.T, and E.T

4. <u>The number of escape trials between the first and the second avoidance responses.</u>

Kamin (61) reasoned that the best test for the effect of a variable

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61. Kamin, L. J. The gradient of delay of secondary reward in avoidance learning tested on avoidance trials only. *J. comp. physiol. Psychol.*, 1957, 50, 450 - 456

on the frequency of avoidance responses is the number of escape responses that occur between the first and the second avoidance trials. This measure will test the effect of the independent variable only, that is independently of the effect of other variables in the situation, such as the number of CS -US pairings, or differences in practice of the escape response during avoidance training. The mean trial of the second avoidance trial was 23.7 for A.T group, 14.5 for F.T group, and 11.4 for the E.T group. This data was not analyzed statistically as our concern is for the number of escape trials between the first and the second avoidance trial which was determined for the three groups. The mean was 3.8 for A.T group, 4.0 for F.T group, and 4.3 for E.T group. A Mann-Whitney U-test to determine the significance between the three groups gave values that are not significant at 0.05 level as can be seen from Table 6. On this measure, the results indicate that there

GROUPS		U	P
E.T vs F.T	Escape vs Fear	25.17	N.S.*
A.T vs E.T	Avoidance vs Escape	24.85	N.S.
A.T vs F.T	Avoidance vs Fear	29.05	N.S.
*Not significant at 0.05 level			

Table 6. Summary of the Mann-Whitney U-test for groups A.T, F.T, and E.T, on the number of escape trials between Av_1-Av_2

is no significant differences even between A.T and each of the other two pre-trained groups E.T and F.T.

6. <u>Response latency.</u>

The mean latency of the responses, both escape and avoidance per day, for the median* S or Ss in groups A.T, F.T, and E.T is represented graphically in Figure 1.

From the graph, there appears a big difference in over-all latency between the F.T group and the E.T group, a difference that later disappears as response latency decreases. Thus a t-test was made on the response latency of the two groups on the first day of avoidance training. The t-value was 1.45 indicating no significant differences between the two groups in this aspect when all individual Ss are considered.

Considering the response latency on escape trials only for the first day of avoidance training, a significant difference at the 0.02 level according to the Mann-Whitney U is found between the E.T and F.T groups indicating the influence of prior training on the escape response in the E.T group. However, this significant difference does not hold between the two groups when the latency of the avoidance response is considered.

7. <u>Inter-trial responses.</u>

In avoidance training where a signal is used, inter-trial responses have no known function as yet. Therefore, if S has learned to discriminate properly, avoidance responses will be made to the signal, and a decrease in inter-trial responses will occur.

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*The criterion is that of number of days to reach criterion of eight avoidances per day.

Comparing the three groups on this criterion, the number of inter-trial responses per day for the median S or Ss in the three groups is presented graphically in Figure 2. The E.T group shows the highest number of inter-trial responses. This may be attributed to the nature of their pre-training of shock-responses where the escape response is learned as indicated by its short latency prior to the avoidance training. The F.T on the other hand, had no such pre-training.

Though there is a difference between the mean inter-trial responses on the first day between the E.T and the F.T groups it is not significant at 0.05 level according to the t-test.

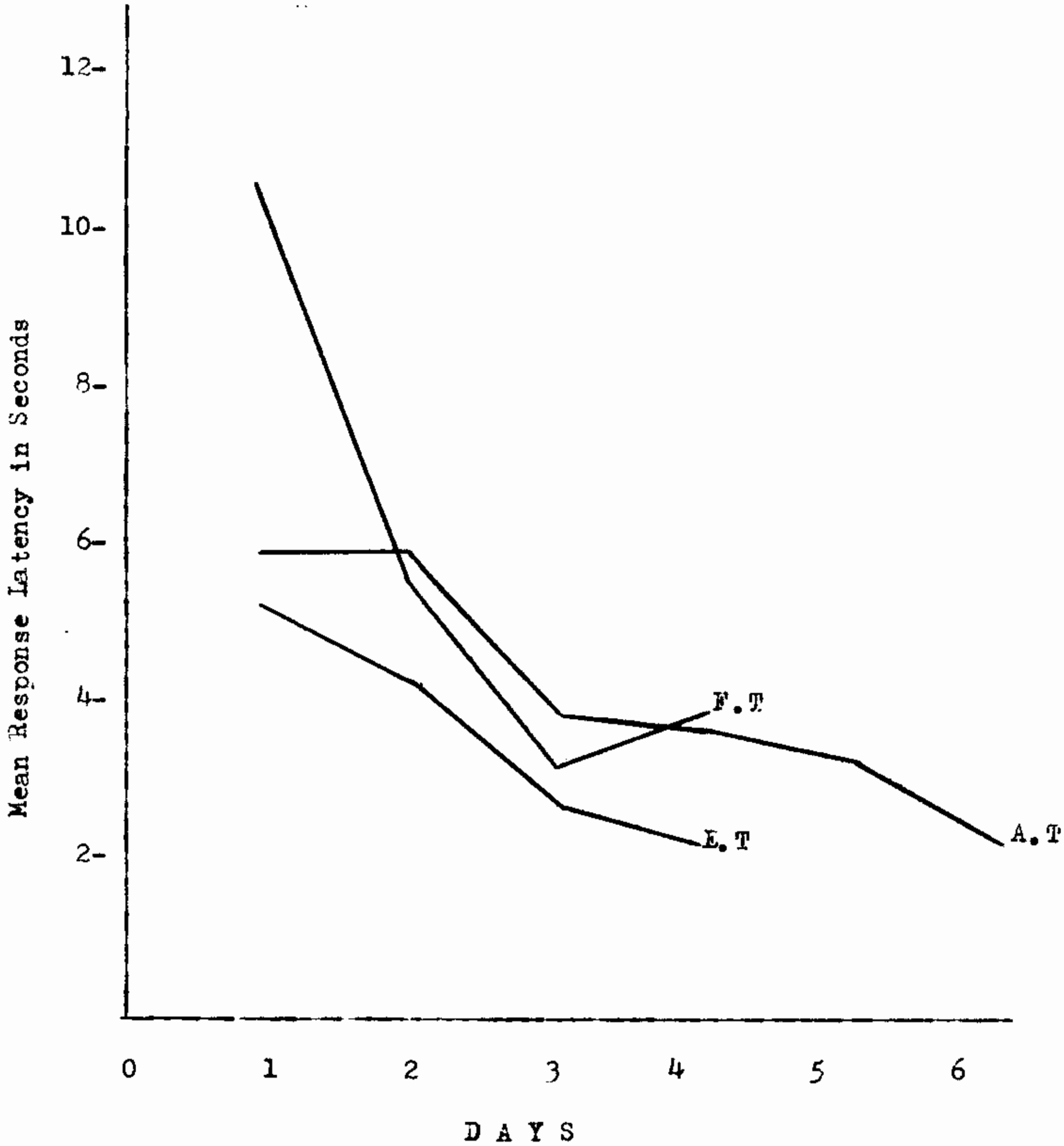

Figure 1. Mean Response Latency per Median S in each of the Three Groups per Day.

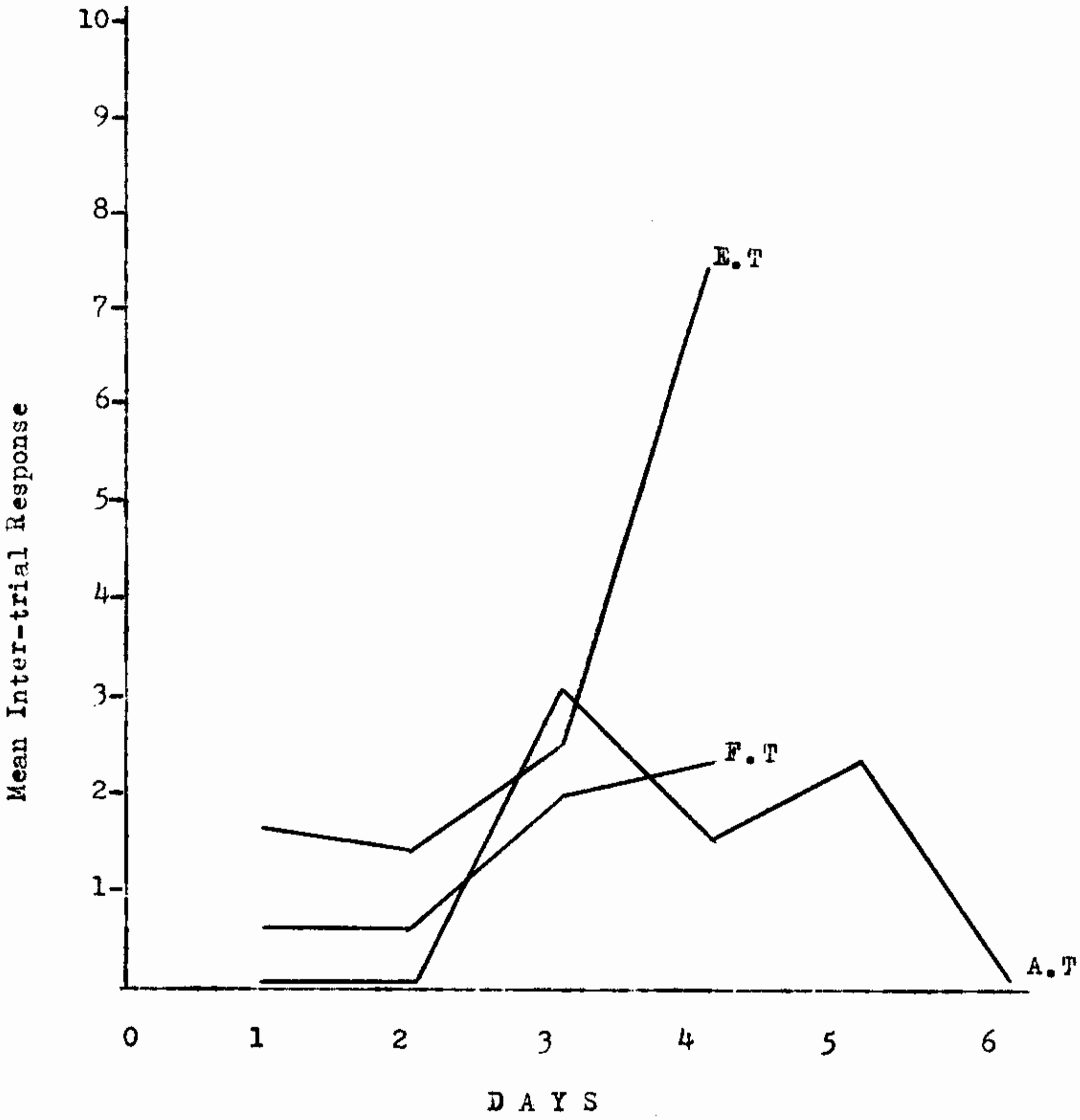

Figure 2. Inter-trial Responses per Day per Median S in the Three Groups Respectively.

CHAPTER V

Discussion and Conclusion

The results presented in the previous chapter clearly indicate that there were no significant differences found between the "fear" pretrained group (F.T) and the "escape" pretrained group (E.T.) on any of the following measures:

(1) Number of avoidance training days to reach criterion.

(2) Number of trials from the first avoidance trial to the last trial.

(3) The occurrence of the first avoidance response trial.

(4) Number of escape trials between first and second avoidance trial.

(5) Response latencies on the escape and avoidance trials.

(6) Avoidance response latencies.

The only significant difference between the two groups was found in the mean escape response latencies. This difference in favor of the E.T group can be attributed to the effect of practice on the escape response in the 40 trials of the pretraining period.

The results, however, indicate a significant difference between both the F.T and the E.T groups on the one hand and the A.T group on the other, in favor of the two pretrained groups on the following measures:

(1) Number of avoidance training to reach criterion.

(2) Number of trials from the first avoidance trial to the last trial.

(3) The occurrence of the first avoidance response.

Thus it appears that it makes no difference whether the animals are pretrained on "fear" (C.S - U.S - U.R) or on "escape" (U.S - U.R - Escape C.R) when these animals are put in an avoidance situation where both conditions are present (C.S - U.S - C.R) plus the possibility of avoidance. The study by Baron, Broakshire and Littman and reported by Ader (62) in which the effect of electric shock presented alone at any time prior to the avoidance learning conditions leads to superior performance in these conditions, is in line with this finding. However, the part chosen from the avoidance chain for pretraining, is different from that of the present study. This part being shock-response to shock and neither signal-shock-response to shock nor shock-response to shock-escape response.

The results of Stanely and Monkman (63) are inconsistent with both of the above findings. They found that the group which was pretrained on escapable shock (i.e. U.S-U.R-C.R) was superior in the avoidance situation to the group that had inescapable shock (C.S-U.S). They attributed their results to a positive transfer effect. The escape group had been trained on escape in response to the signal followed by the shock. This response which was blocked for the fear pretrained group can be made in the avoidance situation. Therefore positive transfer between the two situations is possible since the same response can occur in both situations of stimulus-response. This

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62. Ader, op.cit

63. Stanely & Monkman, op.cit

interpretation, however, omits the possibility of any effective positive transfer of the "fear" response evoked by the signal-shock. This response elicited by the signal shock is also common to the fear pretraining situation as well as the avoidance situation.

In the present study both pretrained groups whether on signal-shock or shock escape, were superior to the group that had no pre-training. The unpretrained group took significantly longer to reach criterion from the reference point of the first avoidance trial. The number of days it took each group to reach criterion (7 days) may not be a valid measure since the four days of pretraining were arbitrarily chosen and no avoidance response could have occurred then. Thus, though the first avoidance response occurred earlier in the unpretrained group, this group which had the opportunity for both signal-shock and shock-escape training did not perform better than any of the pre-trained groups. This demonstrates the facilitative effect of pre-training on avoidance behavior.

What factor or factors do these two pre-training schedules have in common so that they both facilitate avoidance performance? They both include exposure to shock preceded by a signal. A number of interpretations are possible. Baron, Broakshire and Littman in Ader (64) have shown that exposure to electric shock alone was enough to facilitate avoidance learning involving electric shock stimulation. They do not offer an interpretation as to why pre-shock has this effect.

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64. Ader, op.cit

Aside from this empirical fact two interpretations can be suggested. The shaping hypothesis holds that pretraining or repeated exposure to one part of the avoidance behavior chain, whether in the E.T or in the F.T groups facilitates later learning of the total chain. This interpretation may include the first, since repeated exposure to shock alone could form a stimulus-response connection which is part of the avoidance chain. Another possibility is Mowrer's fear hypothesis. The fear response first evoked by the abnoxious stimulus or shock, comes to be elicited by the signal or cues associated with shock. However, according to this interpretation the F.T group should have performed better than the E.T group as their pre-training schedule included a specific signal to which fear reactions could be attached. This however may not be true if the cues of the apparatus functioned equally as fear elicitors for the E.T group.

The A.T group not being superior to the other groups, though exposed to the signal-shock-response sequence that is, the whole chain, gives further evidence (65)(66) contrary to the classical interpretation of avoidance learning. This interpretation holds that the avoidance response is an escape response which moves forward in time, and eventually anticipates shock. If this hypothesis was correct one would expect the A.T group to be superior to others.

The fact that there were no differences between the two pretrained groups in the results of this study may be partly due to

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65. Keehn

66. Mowrer & Lamoreaux, op.cit

the arbitrary choice of the pre-training period. Further experimentation with this variable is necessary before this can be ruled out. Further experimentation may indicate that a shorter period of pretraining is sufficient to shape the avoidance response, offering an interpretation as to why the E.T and the F.T groups were not superior to the A.T group on all measures.

To test further the fear hypothesis, an elimination of all possible cues with which fear reactions may be associated is necessary from trial to trial for the E.T group. This will be difficult to achieve since the visual, auditory and tactual stimuli of the apparatus should be varied from trial to trial.

SUMMARY

After a review of the most important historical developments of the basic theories in the field of avoidance behavior, an experiment was designed to test two opposite views of the basic principles by which avoidance behavior is learned.

The first view (Mowrer) is that avoidance responses are learned both because they provide avoidance of a painful stimulus and reduce the emotional reaction of fear the presence of which depends on cues (special signs) that are repeatedly present when the painful stimulus occurs. According to classical conditioning principles this signal becomes a CS.

The second view (Sidman and Keehn) holds that avoidance behavior is operant and that the avoidance response is shaped by continuous reinforcements that allow for discrimination. According to this view the special warning signal acts not as a CS that elicits a fear reaction but as an S^D that sets the occasion for the right avoidance response.

These two interpretations were compared by an experiment involving the comparison of two groups of rats' performance in an avoidance situation in a Mowrer and Miller shuttlebox. Each of the two groups had a different type of pre-training. The "escape" group was pre-trained without a warning signal on shock trials that could be terminated by the performance of a running response to the other compartment. The escape response in this group is the same as the avoidance response and this pre-training should help in

shaping this response by the elimination of other responses, but fear is not reduced as there is no termination of a warning signal.

The "fear" group was pre-trained on shock trials preceded (5") by a warning signal, a light. The shock's duration was fixed (2") and the animal was not allowed to escape. This pre-training, according to the holders of the first view, should allow through classical conditioning, for the acquisition of the fear reaction.

The two groups had 40 pre-training trials, 10 on each day. Then on the fifth day they were put on an avoidance training procedure of signal-shock-escape response but allowing the response to be made to the signal alone in which case it was considered an avoidance response. A third group was used where animals had no pre-training of any kind but were put in the avoidance training situation directly.

All three groups' avoidance training continued untill each animal made 8 avoidance responses per day.

According to a t-test no significant differences were found between the two pre-trained groups, E.T and F.T, on any of the measures used, that is, number of avoidance training days to reach criterion, number of trials from the first to the last avoidance trials, the occurrence of the first avoidance response trial, number of escape trials between first and second avoidance trial and avoidance response latencies. The results, however, indicate a significant difference between the pre-trained groups both the F.T and the E.T, on the one hand, and the A.T group on the other. The differences are in favor of the pre-trained groups or the first three measures.

The results of this experiment may be interpreted as supporting the shaping hypothesis of operant behavior. Pre-training or repeated exposure to one part of the avoidance behavior chain whether in the E.T or the F.T groups seems to have facilitated later learning of the total chain. According to the fear hypothesis the F.T group should have been superior. However, fear might have been elicited by the cues of the apparatus for the E.T group, thereby decreasing the differences between them.

The results are not very conclusive and a repetition of the experiment is necessary before definite conclusions can be drawn.

APPENDIX I

The Number and Mean of Days to Reach Criterion for all Ss in the Three Groups

Ss	No. of Days to Reach Criterion		
Group	F.T	E.T	A.T
1	4	3	4
2	1	3	6
3	3	6	13
4	3	4	14
5	6	3	4
6	2	2	5
7	3	4	8
8	7	3	
9	4	3	
10	2		
Total	35	31	54
Mean	3.5	3.4	7.7

APPENDIX II

Number and Mean of First and Second Avoidance Trial and the Escape Trials Between them for the Three Groups

An.	Av_1	Av_2	Escape Trials Between Them
1	1	4	2
2	2	4	1
3	14	16	1
4	9	14	4
5	25	29	3
6	5	7	1
7	14	16	1
8	20	45	24
9	4	5	0
10	1	5	3
Total			
Mean	9.5	14.5	4.0

(F.T) Fear-Trained Group

An.	Av_1	Av_2	Escape Trials Between Them
1	16	24	7
2	11	13	1
3	8	27	18
4	2	3	0
5	4	5	0
6	5	7	1
7	6	7	1
8	2	4	1
9	1	13	11
Total			
Mean	6.1	11.4	4.3

(E.T) Escape-Trained Group

APPENDIX II (CONT'D)

An.	Av_1	Av_2	Escape Trials Between Them
1	20	23	2
2	8	11	2
3	26	28	1
4	16	23	6
5	15	25	9
6	11	17	5
7	36	39	2
Total	132	166	27
Mean	19	23.7	3.8

(A.T) Avoidance-Trained Group

APPENDIX III

Mean Overall Latency in Seconds Per Day of Avoidance Training

F.T Group

Ss	Days	1	2	3	4	5	6	7
1		7.9,	7.8,	3.7,	3.9			
2		4.4						
3		13.9,	5.1,	2.8				
4		8.3,	4.7,	2.6				
5		12.6,	10.3,	6.3,	4.4,	4.2,	2.9	
6		5.2,	2					
7		18.1,	6.5,	3.2				
8		42.5,	14.4,	11.1,	9.6,	7.5,	5.1,	3.1
9		5.4,	4.4,	5.2,	1.6			
10		6.6,	2.2					

E. T Group

Ss	Days	1	2	3	4	5	6
1		6.4	4.8	3.9			
2		5.4	6.5	2.9			
3		19.0	7.1	5.8	6.1	4.8	3
4		4.8	3.9	3.8	2.3		
5		4.5	3.2	1.3			
6		4.4	2.4				
7		5.6	5.5	4.1	2.2		
8		5.0	4.9	2.9			
9		5.5	3.7	2.8			

APPENDIX III (CONT'D)

A.T Group

DAYS

Ss	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	6.5,	6.3,	4.8,	3.2										
2	6.1,	6.1,	3.9,	3.8,	3 ,	2.2								
3	7.3,	6.2,	5.4,	4.8,	5.9,	4.9,	3.7,	4.4,	4.1,	4.2,	5.5,	4.7,	2	
4	7.5,	6.8,	3.5,	4.2,	4.5,	5.1,	5.8,	6.2,	6.7,	5.5,	4.4,	5.6,	5,	3.2
5	10 ,	7.3,	5.7,	3.2										
6	7.5,	5.1,	5.8,	4.4,	3.7									
7	7.8,	7.1,	11.3,	12.5,	5.4,	5.3,	3.1,	1.3						

APPENDIX IV

Mean Latency of the Escape Response for E.T Group on Days of Escape

Pre-Training

	DAYS			
Ss	1	2	3	4
1	5.2	9.8	3.6	1.8
2	6.3	8.1	3.1	1.1
3	21.5	5.4	7.6	4.1
4	26.1	15.1	9.1	2.6
5	2.1	1.3	1.9	0.9
6	5.9	4.4	7.8	6.4
7	2.5	1.2	2.0	1.8
8	1.5	2.5	1.8	1.6
9	7.6	1.2	0.8	0.5

APPENDIX V

Trials from First Avoidance Trial to Last Trial

	N OF TRIALS		
Ss	A.T	F.T	E.T
1	20	39	14
2	52	8	19
3	104	16	52
4	124	21	38
5	25	35	26
6	39	15	15
7	44	16	34
8		50	28
9		36	29
10		19	
Total	408	255	255
Mean	58.2	25.5	28.3

BIBLIOGRAPHY

1. Ader, R. The effects of early experience on subsequent emotionality and resistance to stress. Psychol. Monog., 1959, 73, 1 - 31

2. Brown, J. S. & Jacobs, A. The role of fear in the motivation and acquisition of responses, J. exp. Psychol., 1949, 39, 747-759.

3. Bugelski, B. R. The psychology of learning. New York, Holt. 1956.

4. Chevalier, J. A. & Levine, S. The effects of shock and handling in infancy on adult avoidance learning. Amer. Psychol., 1955, 10, 432.

5. Gibson, E. I. The role of shock in reinforcement. J. comp. physiol. Psychol., 1952, 45, 18-30.

6. Hilgard, E. R. & Marquis, D. Conditioning and learning, New York, Appleton Century Crofts, 1940.

7. Hull, C. Principles of behavior, New York, Appleton Century Crofts, 1943.

8. Kamin, L. J. The gradient of delay of secondary reward in avoidance learning tested on avoidance trials only. J. comp. physiol. Psychol., 1957, 50, 450-456.

9. Keehn, J. D. The effect of a warning signal on unrestricted avoidance behavior. Brit. J. Psychol., (in press)

10. __________. On the non-classical nature of avoidance behavior. Amer. J. Psychol., (in press)

11. Levine, S., Chevalier, J. A. & Korchin, S. J. The effects of early shock and handling on later avoidance learning. J. Pers., 1956, 24, 475-493.

12. May, M. A. Experimentally acquired drives, J. exp. Psychol., 1948 38, 66 - 77.

13. Miller, N. E. Learnable drives and rewards. In S. S. Stevens (Ed.) Handbook of experimental psychology, New York, Wiley, 1950.

14. Mowrer, O. H. Learning theory and personality dynamics. New York, Ronald Press, 1950.

15. Mowrer, O. H. & Aiken, E. G. Contiguity vs. drive reduction in conditioned fear, temporal variations in conditioned and unconditioned stimulus. Amer. J. Psychol., 1954, 67, 26-38.

16. Mowrer, O. H. & Keehn, J. D. How are inter-trial avoidance responses reinforced. Psychol. Rev., 1958, 65, 209-221.

17. Mowrer, O. H. & Solomon, L. N. Contiguity vs. drive reduction in conditioned fear. The proximity and abruptness of drive reduction. Amer. J. Psychol., 1954, 67, 26-38.

18. Pavlov, I. Conditioned reflexes. (Anrep, G. V., translator) Oxford, Oxford University Press, 1927

19. Sheffield, F. D. Avoidance training and the contiguity principle. J. comp. physiol. Psychol., 1948, 41, 165 - 177.

20. Sidman, M. Two temporal parameters of the maintenance of avoidance behavior by white rats. J. comp. physiol. Psychol., 1953, 46, 253-261.

21. ________. Delayed punishment effects mediated by competing behavior. J. comp. physiol. Psychol., 1954, 47, 145-147.

22. ________. Some properties of the warning stimulus in avoidance behavior. J. comp. physiol. Psychol., 1955, 48, 444-450.

23. ________. Conditioned reinforcing and aversive stimuli in an avoidance situation. Trans. N.Y. Acad. Sci., 1957, 19, 534-544.

24. Skinner, B. F. Science and Human Behavior. New York, Macmillan, 1953.

25. Solomon, R. L., Brush, E. S. Experimentally derived conceptions of anxiety and aversion, in Jones, M. R. (Ed) Nebraska Symposium on Motivation. Lincoln, University of Nebraska Press, 1956.

26. Solomon, R. L. & Wynne, L. C. Traumatic avoidance learning: The principles of anxiety conservation and partial irreversibility. Psychol., Rev., 1954, 61, 353-385.

27. Stanely , W. C. & Monkman, J. A. A test for specific and general behavioral effects of infantile stimulation with shock in the mouse. J. abnorm. soc. Psychol., 1956, 53, 19 - 22.