THE GENERALIZATION OF AN APPARENT ADAPTATION EFFECT

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By

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SCOPE AND CONTENTS:

This study investigated whether adaptation (lessened emotional reactivity) to electric shock is specific to the environmental situation in which experience with shock is had. The conditioned emotional response (CER) described by Estes and Skinner was utilized, with rats as subjects. Four experimental groups received experience with shock in four different environments, graded in terms of their similarity to the environment in which the CER was later to be measured; a control group received no shock before CER training. The four experimental groups acquired the CER less rapidly than did the control group, but did not differ among themselves. The effect thus appeared to be non-specific; however, some aspects of the data suggested that the effect may not in fact be attributable to an adaptation process.

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CHAPTER ONE

INTRODUCTION AND HISTORY

The research to be reported stems from earlier observations that, when animals have been given prior experience with noxious electric shock, their subsequent emotional reactivity to shock is greatly diminished. The present research attempted to discover how much this apparent "adaptation" to noxious stimuli depends on the similarity of the environments in which the prior and subsequent shocks are administered. This question seemed pertinent because of recent experimental findings by Miller (1960) and by Kamin (1961b). These studies suggested the possibility that adaptation might be quite specific to the situation in which the previous noxious stimulation has been experienced. That is, the animal may, as a result of earlier experience, have a lessened emotional reactivity to shock only in situations very similar to that in which the earlier shock occurred. However, before these directly pertinent experiments can be described, it will be necessary to review briefly some of the extensive earlier work on the conditioned emotional responses, the training technique used in this study. We shall then turn to studies on the general problem of adaptation. Finally, the two experiments from which the thesis problem directly arose will be described.

The CER

This phenomenon was first described in a classical paper by Estes and Skinner (1941) entitled "Some Quantitative Properties of Anxiety". The authors were principally concerned with the disruptive effects which "anxiety", produced by a warning signal which preceded shock, would have on the ongoing, stable operant behaviour of a trained animal subject. Specifically, they investigated the disruptive effects of experimentally induced "anxiety" upon a hunger-motivated lever pressing response in the rat. Their procedure involved placing the rat in a small, relatively sound and light-proof compartment called a Skinner box, which was equipped with a lever and a food delivery mechanism. The rats were taught to obtain food pellets by pressing the lever. At the beginning of training, the animals received a pellet of food every time it pressed the bar. The rats were later shifted to a partial reinforcement schedule, that is, bar presses were only occasionally followed by food. This schedule eventually resulted in a stable rate of response during the experimental session.

The "anxiety" producing condition was then introduced by presenting paired tone and shock sequences to the rat while it was bar pressing at a stable rate. Repeated presentations of a 5 minute tone (the CS) followed by an unavoidable electric shock (the US) were assumed to produce an "anxiety state" whenever the tone was presented. This was indicated by the fact that, during the tone, the rat's rate of pressing diminished or stopped completely. In addition, there were other signs of emotional disturbance during the tone such as urination, defecation, and "freezing". This phenomenon is referred to as the conditioned emotional response (CER), and has since been used extensively in the experimental investigation of anxiety.

While various procedural modifications have been utilized by subsequent investigators, the basic Estes-Skinner technique has remained as the core of a considerable body of experimentation on aversive emotionality. No effort will be made to review this literature in detail; summaries have already been provided by Sidman (1960) and by Annau (1960). It can be noted, however, that CER research falls naturally into 2 classes. For about 15 years following the Estes-Skinner study, emphasis was placed almost exclusively on the CER as an index of fear in research guided by "clinical" or therapeutic conceptions; for example, studies on the effects of electro-convulsive shock treatments (Hunt and Brady, 1951; Brady and Hunt, 1951; Brady and Hunt, 1952); of drug treatments (Hill, Belleville and Wikler, 1954; Brady, 1957); and of brain lesions (Brady and Nauta, 1955). More recently a number of parametric studies concerned with the CER itself have appeared.

Three parameters of the CER have received detailed examination. There exist studies on the effects of temporal relations between CS and US (e.g., Libby, 1951; Stein, Sidman and Brady, 1958; Kamin, 1961a); on the effects of intensity of the US (e.g., Brady and Buela, 1955; Annau and Kamin, 1961); and on the generalization of the CER to CS's similar to, but different from, the CS employed in acquisition (e.g., Ray and Stein, 1959; Fleshler and Hoffman, 1961). The last named area is the one most relevant to the present study, and the two studies on stimulus generalization and the CER will now be described.

The first such study is by Ray and Stein (1959), in which an 1800 cps tone served as the CS in the CER procedure. A 200 cps tone was also presented during the experimental session, but it was never followed by shock. This procedure resulted in suppression of bar pressing to the 1800 cps tone, but not to the 200 cps tone. Ray and Stein then tested for generalization of suppression, using tones lying between 1800 and 200 cps, and found that the amount of responding to the test frequencies was an inverse function of their similarity to the 1800 cps tone. These results are thus seen to be consistent with those of many other demonstrations of generalization.

The Ray and Stein study involved a demonstration of generalization using a discrimination procedure during training; another study by Fleshler and Hoffman (1961) reported a generalization effect without such discrimination training. In the Fleshler and Hoffman study, a 1000 cps tone terminating in unavoidable electric shock was periodically presented to hungry pigeons while they pecked a key for food. When the pecking response was completely disrupted by the tone, the shock was disconnected. The training tone (1000 cps), and tones having different frequencies were then presented. Initially, the gradient of generalization was broad; as testing proceeded, however, the gradient narrowed considerably. These studies thus demonstrate that, like other conditioned responses, the CER will generalize to stimuli similar to that to which it was originally conditioned.

The parametric studies of the CER seem to support 2 conclusions, one of more general relevance, and one more directly relevant to the present research. In general, as Annau (1960) has indicated in detail, the studies support the common notion that the CER is mediated by classically conditioned responses to the CS, which are incompatible with operant behaviour. This assumption is supported by the fact that the CER has been shown to vary in response to the same factors which control classical Pavlovian conditioning.

With respect to the present study, it is clear that the magnitude of the emotional response to the CS diminishes when a test is made with a CS similar to, but different from, that employed in original training. We shall be asking a related but different question. Will an operation which seems to diminish the emotional responsiveness to the CS exert this effect in situations similar to, but different from, that in which the operation is administered?

Adaptation

We turn now to a consideration of experiments which deal with the effects of previous exposure to aversive stimuli on subsequent reactivity to such stimuli. There are numerous studies (we shall cite only a few) which suggest that when aversive stimuli are repeatedly presented to an animal, the animal will eventually cease to respond.

For a classical example, a 1930 study by Humphrey using snails (Helix Albolabris) as subjects, reported that when the sub-stratum on which the animal was walking was subjected to a mechanical shock, the animal's tentacles were immediately withdrawn. However, it was found that if the mechanical shock was administered repeatedly, at regular intervals, the extent of the tentacle withdrawal steadily decreased, until finally the animal became completely indifferent to the stimulus.

A similar study was recently reported by Clark (1960) who investigated adaptation in Nereis pelagica, the polychaete worm. He reported that the worms, when first stimulated by a moving shadow or by mechanical shock, would respond with a sudden flick-like body movement. With repeated stimulation, these animals adapted with great rapidity to the stimuli. The adaptation persisted for as long as 17 hours.

The adaptation phenomenon is by no means limited to lower phyla. Turning to mammals, Kimble (1955) employed a psychophysical method of limits technique to determine the response of rats to electric shocks ranging from 0.0 ma to 0.9 ma. He obtained significant evidence of adaptation by comparing the shock thresholds in the first and second halves of the experiment. Thresholds of a jumping reaction to 160 shocks, spaced 30 seconds apart, were found to be significantly higher in the second half of the experiment.

For a final example, at the human level, Seward and Seward (1934), administered a series of 5 intense electric shocks in 29 separate daily training sessions. The experimenters took daily measures of the psycho-galvanic reflex, breathing and general body movements. As the experiment progressed, they found evidence of adaptation to shock in all of these response measures. In addition, the subjects reported that the shocks began to seem increasingly less unpleasant and disruptive.

The studies just outlined serve to illustrate the wide generality of the phenomenon of adaptation. We shall employ the term "adaptation" to refer to the usually observed reduction of emotional responses in the course of repeated presentation of aversive stimuli. This term, then, should not be confused with sensory adaptation, which generally refers to short-term predominantly peripheral processes in the receptors, rather than to phenomena presumably mediated by the central nervous system. We should make clear also that no attempt will be made to cover exhaustively the entire host of adaptation studies, rather, selected papers will be cited to illustrate relevant aspects of the phenomenon.

The studies previously reviewed have demonstrated decreasing reactivity to noxious stimulation in the course of repeated presentation of the noxious stimulus. We turn now to a consideration of studies dealing with the effects of previous experience with aversive stimuli (e.g., air puffs, shocks) upon subsequent conditioning which then employs the same aversive stimulus.

McDonald (1946) refers to some early exploratory work in which she attempted, using humans as subjects, to condition a finger withdrawal response to an electric shock. Some of the subjects, in spite of increasing shock intensities, failed to condition, reporting that they "got used to the shock".

McDonald (1946) then investigated the effects of systematically controlled adaptation experience upon the later acquisition of a finger flexion response (using electric shock as the US), and an eyeblink response (using a corneal air puff as the US). She found that when subjects were first given adaptation shocks or puff presentations, their performance during the later conditioning procedure was significantly poorer than that of control subjects receiving only the conditioning trials.

Another similarly oriented experiment by Kimble and Dufort (1956) investigated the strength of eyelid conditioning as a function of different numbers of CS-US pairings. One group received 20 presentations of the air puff alone before the conditioning trials were initiated. The previously administered US presentations were found to retard subsequent conditioning.

Taylor (1956) using humans as subjects, did a study of the conditioned eyeblink response. The subjects received a series of air puff stimulations (US alone) before the start of the conditioning trials. A decrement in conditioning performance was reported as in the McDonald and Kimble and Dufort studies. In addition, this decrement was found to be a monotonic function of the air puff intensity used during the adaptation procedure. Subjects given intense air puffs in the preliminary phase of the study showed the greatest adaptation.

While the authors of these 3 studies differ somewhat in their theoretical interpretations, the empirical data are clearly in agreement. Each of these reports indicates that prior experience with an aversive US retards subsequent acquisition of a CR motivated by that same US. The 2 studies which follow are in agreement with this general rule, but, bearing more directly on the present experiment, the US is electric shock and the subjects are rats.

Investigating the effects of using shock to punish rats for errors in a discrimination situation, McCullogh and Bruner (1939) gave one group of rats a 10 day period of pre-shock, and gave no shocks to a group of control animals. During the pre-shock period the experimental rats were reported to have shown increasing adaptation in their behavioural responses to the shock (i.e., from vigorous biting of the grid bars and walls of the box at first, to a later "passive" crouching). This group was then found to do significantly more poorly in the learning of a brightness discrimination task than the group receiving no prior shocks. Thus, for the adapted rats shock was a relatively ineffective aversive stimulus during the discrimination training.

Steckle and O'Kelly (1941) placed rats in special cages at 20 days of age, where water could be obtained only by standing on a continuously electrified grid. This phase of the experiment continued for 32 days. Other animals served as a control group for the effects of severe water deprivation per se during the 32 day period. The test situation consisted of a runway electrified in the centre portion. When testing began, a further control group of normally reared animals was added. All animals were then trained in the runway (with water as the incentive and without shock) until they had reached a running time criterion. The centre portion of the runway was then electrified. There were more crossings of the runway grid for water by the previously shocked (adapted) experimental animals, than by the control animals which had had no previous exposure to shock. The experimental group also showed greater resistance to extinction than either of the control groups when the water reinforcement was discontinued.

The results of the studies so far outlined by this section are readily accounted for by some such notion as adaptation. However, it is necessary to point out that there are studies which, while seeming to fit the adaptation paradigm, produce paradoxically different results. This empirical paradox is reflected at the conceptual level, where one encounters two "intuitive" theoretical notions in this connection, both in the experimental and in the clinical literature. These theoretical notions are antithetual, and can thus "account for" any empirical result. Roughly, one position maintains that previous experience with shock "sensitizes" or traumatizes an animal, that is, predisposes it in some way to respond with increased emotionality in later aversive situations. The other view holds that prior experience with shock serves to "toughen up" or "adapt" an animal, thus causing it to react with less emotionality in later aversive situations. We have cited extensive evidence for the adaptation notion. Two studies which lend themselves more easily to the "sensitization" view will now be outlined.

Baron, Brookshire, and Littman (1957) investigated the effects of subjecting groups of rats at different age levels (20 days, 36 days, and adults) to a series of "intensely traumatizing" shocks. At adulthood these groups of rats were trained in an avoidance habit motivated by shock. A group of animals which received no shock experience until the time of testing served as a control for the other groups. The previous experience with shock was found to facilitate the learning of the avoidance habit for all experimental groups. Presumably, the free shock treatments led to an increase of fear in the subsequent aversive situation.

An experiment by Kurtz and Pearl (1960) seems to indicate a sensitization effect similar to that obtained by Baron, Brookshire and Sittman. Kurtz and Pearl used young (30 days old) rats, and subjected them to various pre-shock conditions. They found that prior experience with shock predisposed animals to react with increased fear (i.e., they showed greater resistance to extinction than normal controls) in a subsequent avoidance habit motivated by shock.

Thus the literature suggests that both the "adaptation" and "sensitization" effects can occur, depending upon conditions which are not yet understood. Perhaps it is the amount, the pattern, or the intensity of the previous experience with aversive stimulation, or the age of the animal, or the precise nature of the criterion task, or still other factors, which determine whether the effect in the subsequent aversive situation will be sensitization or adaptation. A systematic attempt to isolate the variables which determine whether prior experience with aversive stimulation produces sensitization or adaptation would seem to be of great value, but no such attempt has yet been made.

Is Adaptation Situationally Specific?

The previously cited studies in any event indicate that, under some conditions, prior experience with noxious stimulation can lead to a striking adaptation effect. The particular problem of this thesis - the degree to which adaptation effects, when obtained, are situationally specific - was suggested by 2 recent experiments which will now be outlined in detail.

Using rats as subjects, Miller (1960) attempted to determine whether "resistance to stressful situations" can be learned. His procedure involved, first, training rats to run down an alley to a food reward. When this behaviour had stabilized, the rats were then given shocks at the goal area as they ran to the food. The first shocks administered were of very low intensity, and did not interfere markedly with the hunger-motivated running behaviour. During this phase of the experiment, the intensity of shock was gradually increased. Finally, the experimental animals were required to run through an intense shock in order to get to the food. The running of the experimental animals was much less interfered with than the running of control animals which had received no prior experience with shock before being exposed to the intense shock.

To this point, Miller's experiment seems to be simply a confirmation of earlier work on adaptation. The resemblance to the Steckle and O'Kelly study is quite marked. However, Miller introduced a control group of considerable theoretical interest. These control animals, after the stabilization of the hunger-motivated running habit, were given the same series of gradually increasing shocks as had been given to the experimental rats; however, the shocks were delivered in a separate grill-box, quite dissimilar to the runway. When later introduced to the food - plus - strong shock situation in the runway, these animals showed no beneficial effects of prior experience with shock. They promptly stopped running to the food. Thus, there is some suggestion that adaptation effects may be quite specific to the situation in which the prior stress is experienced. To quote Miller, "Apparently, mere exposure to tough treatment will not necessarily improve resistance to stress in a different criterion situation", (1960, p. 145). The implications of this finding are of obvious practical and theoretical significance.

There is, however, a major difficulty in interpreting this finding of Miller's. His experimental animals, but not his controls, were given shock while in the process of running to food. Thus, they were trained to react to an emotion-eliciting situation in a specific way. While, from a practical point of view, Miller's training procedure "worked", the theoretical question remains open as to whether his experimental rats were ultimately less emotionally reactive to strong shocks, or whether they had merely been trained to continue running, even though as emotionally reactive to the shock as ever. Miller's use of the phrase "resistance to stress" obscures this distinction. Were the animals resisting stress in the sense of raising their thresholds of emotional reactivity, or were they being specifically trained to persist in an "adaptive" instrumental behaviour in the face of strong stress? If the latter is the case, it is scarcely surprising that an instrumental response trained to a given situation should be specific to that situation.

The problem of specific training of the criterion response, however, does not arise in the same form in a series of studies reported by Kamin (1961b), which also suggest a situational specificity of adaptation effects. The main results of Kamin's studies were as follows: using a CER technique, he investigated the effects of previous experience with shock on acquisition of the CER. The previous experience with shock was given to the rat during 10 bar pressing sessions, before the beginning of CER training. Two independent studies showed that previous experience with shock produced a profound decrement in the acquisition of the CER; that is, rats given the experimental treatment of unsignalled shock while bar pressing were very slow, in the subsequent phase of the experiment, to acquire suppression to a CS preceding shock. Further, the degree of retardation in acquiring suppression was shown to be a monotonic function of the intensity of the prior shocks; rats given strong prior shocks were more retarded in acquiring suppression than were those given weak shocks. These findings were all attributed by Kamin to an "apparent adaptation effect". That is, it was assumed that the prior experience with shock had diminished its emotion-eliciting capacity, and, that this diminished emotionality was directly reflected in the retarded acquisition of the CER.

To this point, one might argue that, in effect, the hungry rats given prior shocks in the bar-pressing situation in Kamin's study, were being given specific training to persist in bar pressing, much as Miller's animals were trained to run down the alley. The distinction between Miller's and Kamin's procedures in this respect is that Miller's animals were shocked every time they approached food, while in Kamin's situation, 4 brief shocks were distributed during a 2-hour bar pressing session, and any contiguity between bar-pressing or eating and shock was uncontrolled and unpredictable.

However, Kamin next proceeded to train a group of animals which received their prior shocks in the Skinner box while the bar was absent. Thus, for this Bar Absent group, there was no possibility of any contiguity between instrumental bar pressing and shock; one cannot say that these animals received any specific training to continue bar pressing in the presence of shock. The performance of these rats when later given CER training was compared to that of a group which had received its prior shocks while bar pressing (Bar Present group), and to a group which had received no prior shock at all (Control group).

Both the Bar Absent and Bar Present groups showed significantly slower acquisition of the CER than did the Controls. Thus, both displayed the apparent adaptation effect. However, the effect was shown significantly more markedly by the Bar Present group than by the Bar Absent group. The author, in attempting to account for this difference, lay exclusive stress on the possibility of adaptation being situationally specific. He argued, "If one conceives of adaptation as being relatively specific to the situation in which the free shock is administered, the Bar and No Bar conditions can be reasonably regarded as varying along a stimulus generalization continuum from the experimental situation in which the effects of adaptation are later to be observed. The Bar free shocks, delivered in a situation highly similar to the later testing conditions, would then be expected to produce a more profound decrement than the No Bar free shocks", (1961b, p. 186).

Thus, in effect, Kamin argued that prior experience with shock was producing a diminished emotional responsiveness to shock, but that this diminished responsiveness would be displayed maximally only in the specific situation in which prior shock had been experienced. This general approach, of course, is also one way of regarding Miller's data. The present experiment was designed to test this notion.

In both Miller's and Kamin's studies, situational specificity of adaptation is inferred from procedures in which the prior experience with shock is given in only 2 situations - one identical to that in which the subsequent test for adaptation is to be made, and one in some way dissimilar. If the interpretation offered above is correct, it should be possible to demonstrate that adaptation effects progressively weaken as the prior shock is administered in situations progressively less similar to that in which the test is to be made.

The present study employs Kamin's basic procedure. There are, however, 4 experimental groups which are given prior experience with shock in 4 different situations which can be graded in terms of their similarity to the situation in which the CER is later to be acquired. To rule out the possibility of specific training of bar pressing in the face of shocks, the bar was never present when the prior shocks were given. The performance of the 4 experimental groups during CER training is to be compared to that of a control group given no prior shock. The notion of a situationally specific adaptation effect implies that the experimental groups should acquire the CER more slowly than the control group, and that rate of acquisition of the CER should be a monotonic function of similarity of the prior shock situation to the test situation, with the slowest acquisition being shown by the group for which the 2 situations are identical.

This experiment seemed significant for a number of reasons. As has already been indicated, there are suggestions - but certainly not confirmations - in recent studies that adaptation effects may be quite situationally specific.

The present study was designed to contribute toward an answer to this question. In general, the problem of adaptation is one of considerable theoretical and practical importance. Since the repeated use of electric shock in psychological experiments is very common, an improved understanding of adaptation phenomena may help to clarify the results of many experiments. It seems likely, for example, that adaptation phenomena play a large role in studies of punishment, of emotional arousal, etc. On the most far-reaching level an understanding of how, as Miller phrases it, one can teach organisms to "resist stress", and of the conditions under which the learned resistance to stress generalizes to new situations, would be of obvious practical and educational significance. To quote Miller, "It should be feasible and profitable to analyze further at both the animal and human level the laws governing the learning of resistance to stresses such as pain, fear, fatigue, frustration, noise, nausea, and extremes of temperature", (1960, p. 145).

CHAPTER TWO

METHOD

Subjects

Forty experimentally naive male hooded rats, about 5 months old, served as subjects. Before experimental training, they were reduced to approximately 75% of their ad lib body weight, and throughout the experiment were fed in their home cages every 24 hours. The food provided was sufficient to maintain the animal at 75% of its body weight. Water was continuously available in the home cage. Daily experimental sessions began approximately 21 hours after the rat had last eaten.

The 40 subjects were randomly assigned to 5 experimental groups: I, II, III, IV, and C. Because of procedural errors and apparatus breakdowns, one animal from each of Groups I, II, and III, and 2 animals from each of Groups IV and C had to be discarded. The surviving subjects thus numbered 7 for Groups I, II, and III, and 6 for Groups IV and C.

Apparatus

The apparatus consisted of 8 standard Grason-Stadler operant conditioning units, with automatic programming and recording equipment. Each of the 8 Skinner boxes was contained in a sound-proof, heavily insulated chest. Every box contained a response lever, a food cup, and an attached loud speaker.

The CS for CER training was a low volume (70 db) white noise from a Grason-Stadler Model 901A noise generator, delivered to the experimental chamber through the attached loud speaker. The experiment was designed so that a background tone was present during the experimental session. The CS for all groups thus consisted of three minutes of white noise, occurring immediately after termination of the background tone, and was followed by the delivery of the US (shock) and resumption of the background tone.

The US, approximately 1 ma electric shock, was of 0.5 seconds duration, delivered to the grid floor of the experimental chamber from a Grason-Stadler Model E1064GS shock generator. This provided a high voltage, high resistance circuit, plus a built-in grid scrambler. Thus, fluctuations in the rat's resistance had a minimal effect on current flow, and the rat could not avoid shock by standing on any particular set of grid bars.

The experimental design also made it necessary to change various environmental conditions, within the Skinner boxes for different groups of subjects. Two aspects of the environment were manipulated in order to create, within the Skinner boxes, three "situations" which could be graded in terms of their resemblance to each other. The two aspects varied were the brightness of a set of cardboard inserts attached to the four walls and the roof of the Skinner box, and the pitch of a continuously present background tone. The three situations which resulted were as follows:

Situation I — Black walls and roof, and the continuous presence of a 1200 cps tone

Situation II — Grey walls and roof, and the continuous presence of a 600 cps tone

Situation III — White walls and roof, and the continuous presence of a 300 cps tone

It seemed logical to suppose that, within this set of situations, Situation I and III were most dissimilar, with Situation II falling somewhere between them. However, a fourth situation, very much unlike any of the first three, was employed for one experimental group. This involved a completely separate apparatus in which shock could be delivered to the rat. For this purpose, a set of grill boxes were constructed. These were much smaller than the Skinner boxes, and had clear plexiglass walls and roof, with a grid floor. The grill box dimensions were 7¼" x 4¼" x 5", compared to the 9¼" x 7 5/8" x 11½" dimensions of a Skinner box. There was never any tone presented in the grill boxes. Unlike the Skinner boxes, the grill boxes were not enclosed in chests, but were placed on chairs in a large, well lit experimental room.

Procedure

Preliminary training of all subjects was identical, and was always carried out in Situation I. This involved a minimum of 12 hours experience bar pressing under a 2.5 minute variable interval food reinforcement schedule. The daily experimental session was approximately two hours. The first formal experimental day (Day P) was also identical for all subjects. This was a pre-test day carried out in Situation I. The three minute CS was presented four times during this pre-test session at 17, 52, 92, and 112 minutes after the beginning of the session. This was done to find out whether the CS, before being paired with shock, affected the pressing response.

Adaptation Training

During this phase of the study, the bars and food cups were removed from the Skinner boxes. The animals were still placed in the apparatus for two hours daily, and 1.0 ma, 0.5 second shocks were delivered at 20, 55, 95, and 115 minutes after the beginning of the session. This phase continued for

10 days, so that each rat in the experimental groups received 40 adaptation shocks. Rats in Groups I, II, III and IV received these shocks in Situations I, II, III and IV respectively. Since all CER training was carried out in Situation I, the four experimental groups thus differed with respect to the degree of similarity between the environments in which prior shock and CER training were experienced. This ranged from identical for Group I, to "substantially dissimilar" for Group IV. Group C, during this phase, was placed in Situation I for 10 two-hour sessions, but received no shocks.

CER Training

This training was identical for all five groups, and was carried out with bars and food cups present. The animals again worked under the variable interval food reinforcement schedule, but four CS-US pairings were now superimposed during each daily two-hour session. The CS acted for three minutes, followed immediately by delivery of the US. The CS was presented 17, 52, 92, and 112 minutes after the session began, and was programmed independently of the food reinforcement schedule. CER training continued for 10 daily sessions.

Measures

The basic measure employed in this study, to quantify the CER, was the "suppression ratio" already used by Kamin (1961a, 1961b) and by Annau and Kamin (1961). This ratio consists of the fraction $\frac{B}{A + B}$, with B representing the number of bar presses made by the animal during the three minute CS, and A the number of bar presses made during the three minute period immediately preceding the CS. The ratio has limits of .00 and 1.00, with .00 representing complete suppression of bar pressing during the CS, .50 representing no effect of the CS on bar pressing, and 1.00 representing the case when no responses are made during the three minutes preceding the CS, but some are made during the CS. Printing counters and electro-magnetic counters provided an accurate trial-by-trial record of response rates during periods A and B.

CHAPTER THREE

RESULTS*

Acquisition of the CER

The basic datum of the experiment is a daily suppression ratio. This was calculated separately for each animal on each day by pooling the response rates observed during the four CS-US sequences of a single session. The median daily suppression ratios for all experimental groups are presented in Figure 1.

Insert Figure 1

The figure makes several facts obvious. First, the control animals rapidly acquire virtually complete suppression; this is, of course, the typical finding. Second, all of the experimental groups are considerably retarded in acquisition of suppression, although all groups do display an acquisition curve. Third, the difference between the experimental and control groups gradually diminishes, until, by the end of training, the performances of the various groups are no longer distinguishable. The latter two findings are very similar to Kamin's original report (1961b) of an "apparent adaptation effect". His experimental groups similarly displayed retarded acquisition curves, though eventually they approached the performance of the control animals.

The question of major concern, however, is whether there are differences in performance among the four experimental groups. Figure 1 suggests from

* The raw data are presented in the Appendix

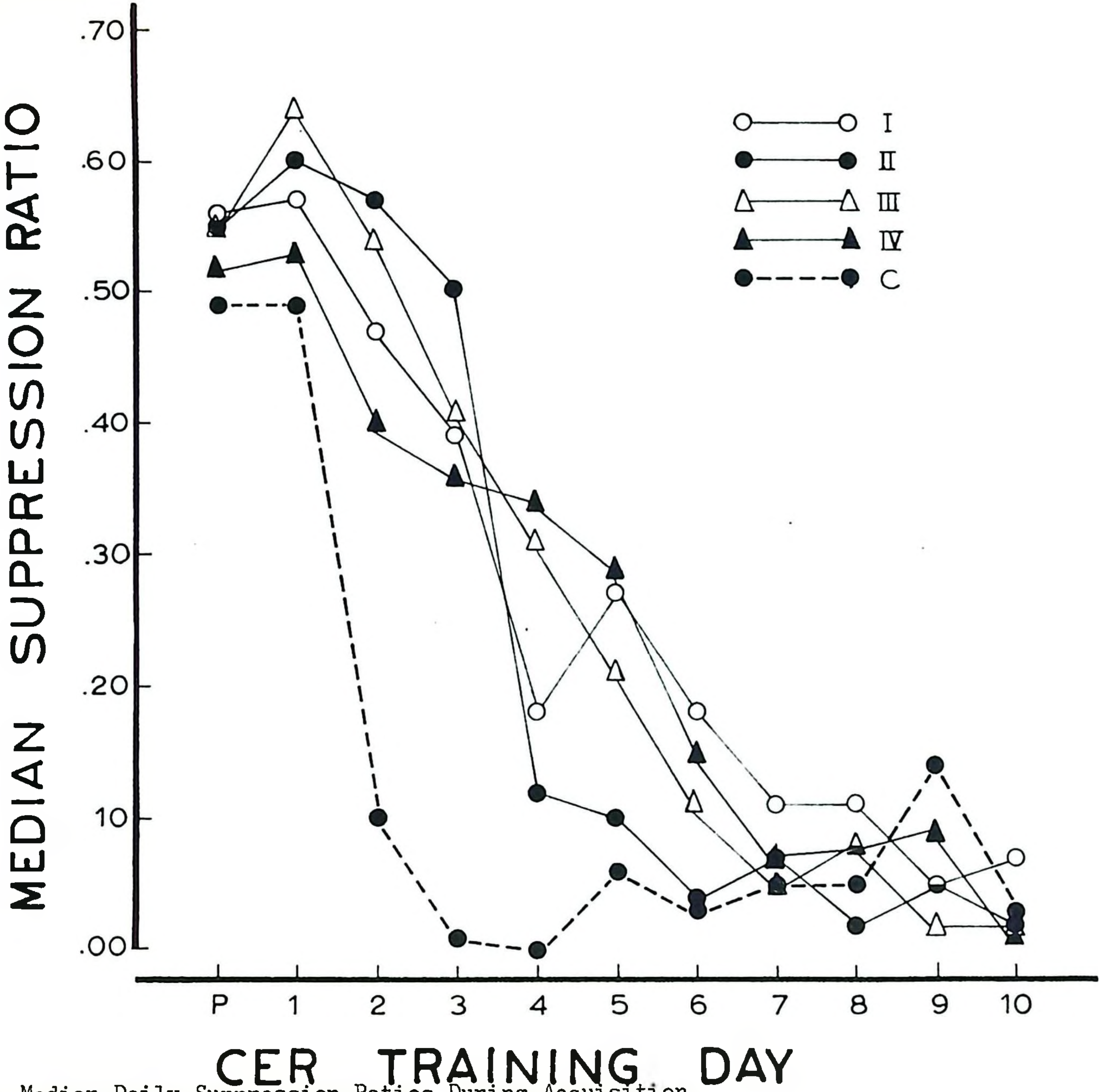

Figure 1. Median Daily Suppression Ratios During Acquisition

inspection that this is not the case. To test this possibility rigorously, mean suppression ratios for Days 1 through 5 (when apparent differences between the groups were maximal) were calculated for each animal. The mean ratio for a given animal was simply the mean of its daily ratios for each of Days 1 through 5. These data are summarized in Table I.

TABLE I

MEAN SUPPRESSION RATIOS FOR DAYS 1 - 5

	GROUPS				
MEASURE	I	II	III	IV	C
Mean	.36	.41	.45	.38	.16
Median	.37	.41	.44	.37	.17
Range	.24 - .45	.24 - .54	.33 - .59	.30 - .49	.08 - .26

The data summarized in Table I were submitted, first of all, to the Kruskal-Wallis ranked analysis of variance. The value of *H* was 16.15, $p < .01$. Thus we can reject the overall null hypothesis, and conclude that there do exist significant differences among the samples. To determine which samples differed from which, the procedure suggested by Ryan (1960) for multiple Mann-Whitney *U* tests was employed. This procedure, by adopting appropriate "adjusted significance levels", controls the error rate "experimentwise" (Ryan) at .05. That is, the probability of falsely claiming <u>one or more</u> significant differences is set at .05, with the entire experiment as the unit. The only significant differences found were between Group C and each of the four experimental groups.[1] Thus, we can conclude that the five samples fall

[1]This conclusion was confirmed by an *H* test performed on the four experimental groups alone. The value of *H* was 3.71, far short of significance (*p* approximately .30).

into two significantly different clusters, with Group C forming one cluster and Groups I, II, III, and IV the other. The separation of these clusters is quite extreme. Only one animal in Group C had a ratio overlapping those of the experimental animals; its ratio was .26, greater only than a .24 ratio of a Group I animal and a .24 ratio of a Group II animal.

The key finding, however, is that there exist no significant differences among the four experimental groups. The failure to find such differences does not seem to be a Type II error, since it will be noted that the order in which the four means fall in no way corresponds to the predicted order. The data indicate quite clearly that prior shock retarded acquisition of the CER by the experimental groups, but that the degree of retardation was independent of the similarity between the environments in which prior shock and CER training were given.

It is of some interest to compare the mean ratios for Days 1 - 5 with the similar statistics for comparable groups in Kamin's earlier study (1961b). His control group had a mean ratio of .15, with a range of .08 - .25; this is virtually identical to our control group's mean of .16 with a range of .08 - .26. His most comparable experimental group (trained at the same shock intensity employed in the present study, with no bar present during prior shocks) had a mean ratio of .32, with a range of .19 - .51. This seems roughly comparable (cf. Table I) to the values of our experimental groups, even though several changes in apparatus had intervened.

<u>Baseline Data</u>

The baseline rate of bar pressing is generally affected by the delivery of shock, and we turn now to the question of whether differences exist among the experimental groups in this respect. Unfortunately, a rigorous analysis of baseline data is difficult to perform. There are wide individual differences in baseline rates among animals, and the experimental groups are small in number. Further, baseline rates are quite sensitive to day-to-day changes in temperature and humidity, to external noises in the experimental room, etc. Nevertheless, in view of Brimer and Kamin's (1961) recent suggestion that the apparent adaptation effect may be intimately connected with shock-induced changes in baseline rate, it seems worthwhile to examine what data we have.

To examine these data, a daily baseline rate per minute was computed for each animal. This rate was based upon the animal's responses during the three-minute periods preceding each CS presentation, and is thus a 12-minute sample from the day's session. Figure 2 presents the median rates for all experimental days for all groups.

Insert Figure 2

The data portrayed in Figure 2 were subjected to an analysis of variance summarized in Table II.

TABLE II

SUMMARY OF ANALYSIS OF VARIANCE OF BASELINE RATES

SOURCE	df	MEAN SQUARE	F	p
Between Subjects				
Groups	4	21,246.7	-	
Error (b)	28	31,734.0		
Within Subjects				
Days	10	9,053.2	4.07	<.001
Days x Groups	40	2,952.0	1.33	NS
Error (w)	280	2,222.4		

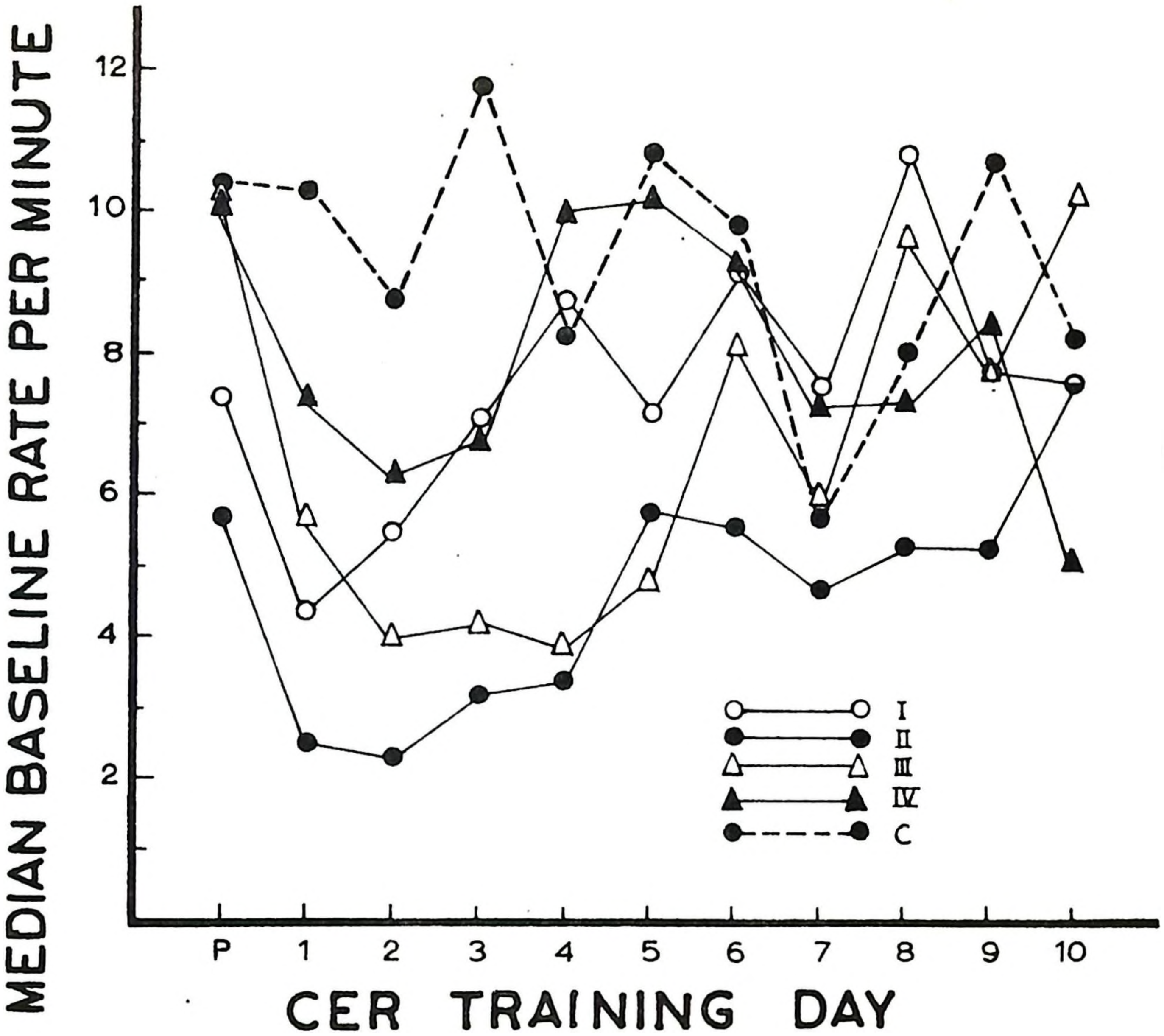

Figure 2. Median Daily Baseline Rates During Acquisition

The only significant effect in the analysis was that of Days; this seems to be in keeping with earlier observations (e.g., Annau and Kamin, 1961) of a decline in baseline rates during the early days of CER training, followed by a gradual recovery. However, an examination of Figure 2 suggests one regularity of potential theoretical significance. It will be noted that all four experimental groups, but not the controls, show a considerable drop in baseline responding between Day P and Day 1. The four experimental groups, of course, have experienced shock during this period, and the control group has not.

To view this in detail, the baseline rate of each animal on Day 1 was computed as a percentage of its baseline rate on Day P. These data are summarized in Table III.

TABLE III

BASELINE RATE ON DAY 1 AS A PERCENTAGE OF RATE ON DAY P

	GROUPS				
MEASURE	I	II	III	IV	C
Mean	56.4	60.3	48.1	69.8	117
Median	48	51	57	56.5	111
Range	6 - 174	3 - 156	0 - 103	27 - 167	54 - 212

When these data for all five groups are submitted to an overall *H* test, the result falls considerably short of significance ($p < .30$, $> .20$). However, if one combines the four experimental groups into a single sample and contrasts their performance to that of the control group, the Mann-Whitney *U* test yields a significant value ($p < .05$). Further, the proportion of animals showing lower rates on Day 1 than on Day P are 6/7, 6/7, 6/7, 5/6, and 3/6 for Groups I, II, III, IV, and C respectively.

Finally, it can be noted that in Kamin's original study (1961b), 6/8 of the experimental animals and only 3/8 of the control animals had lower baseline on Day 1 than on Day P. Combining the data from both studies 29/35 of the experimental subjects, and 6/14 of the controls, showed a drop in baseline. The chi-square for these proportions is 6.02, p <.02. Thus, although it is difficult to demonstrate this effect in an elegant way, the general trend of the data suggests that pre-shocks do tend to decrease the baseline rate of bar pressing. At the least, it can be said that in five independent experimental groups, each of which showed an apparent adaptation effect after 10 days of exposure to 1 ma shock, a considerable majority of the subjects showed lower baselines after this experience; this was not the case in either of the two independent control groups. Also, the drop in baseline was of about the same magnitude for all the experimental groups.

<u>"Supernormal" Ratios</u>

There remains one final aspect of the data which merits closer examination, particularly in view of the very recent report by Brimer and Kamin (1961). The theoretical significance of the problem of "supernormal" ratios will be outlined in the ensuing discussion; for the moment we shall confine ourselves to the empirical question of whether supernormal ratios - ratios <u>higher</u> than those on the pre-test day - were observed on the first day of CER training in the present study. When the ratio is supernormal, of course, the animal is generally responding at a <u>faster</u> rate during the CS than immediately preceding the CS; the mean ratio on Day P is usually very close to .50.

To examine this question, a difference score was computed for each animal between its ratio on the pre-test day and its ratio on CER Day 1. When this difference has a positive sign, the animal has a higher ratio on Day 1 than on Day P; the reverse is true when the difference score is negative in sign. These data are summarized in Table IV.

TABLE IV

DIFFERENCE SCORES (DAY 1 RATIO - DAY P RATIO)

BY EXPERIMENTAL GROUPS

MEASURE	GROUPS I	II	III	IV	C
Mean	+.05	+.04	+.12	+.04	-.04
Median	+.02	-.05	+.09	+.02	-.05
Range	-.08 - +.18	-.13 - +.38	-.14 - +.41	-.05 - +.23	-.09 - +.01

The Kruskal-Wallis test failed to reveal any significant differences among groups on this measure ($\underline{H}$ = 3.26, $\underline{p}$ >.50), nor was the difference between the control group and the four experimental groups pooled significant. The proportions of animals showing supernormal ratios were for the five groups, 4/7, 3/7, 4/7, 4/6, 2/6. Thus, while some supernormal ratios occur - and, as the ranges in Table IV indicate, some fairly high ones occur in the experimental groups - there is not a statistically significant tendency for them to occur.

CHAPTER FOUR

DISCUSSION

Situational Specificity of the Apparent Adaptation Effect

The first question to be raised is whether or not adaptation effects are specific to the situation in which adaptation training has been given. In the present study the apparent adaptation effect was obtained approximately equally in all of the experimental groups, despite considerable variation in the similarity of the pre-shock situations to the CER situation. Since, in other experimental situations, rats easily discriminate environmental differences less striking than those involved here, the effect appears to be remarkably non-specific. Of course, it can be argued that shock or "anxiety" tend to heighten the generalization gradient (e.g., Rosenbaum, 1953; Brown, 1942), and that the animals thus respond to any similarities between the training and test situations. The presence of grid floors in both situations, and the daily handling by the experimenter, might well serve as salient similarities for the rat. However, it seems difficult to believe that variations of the magnitude which we introduced would have no effect on a generalization gradient; and in any event, such an argument would not square with the reports of Miller (1960) and of Kamin (1961b) which prompted this study.

How then are the present results to be reconciled with those of Miller and of Kamin, which suggested a situational specificity of adaptation effects? As has already been pointed out Miller's "adaptation" procedure involved, for his experimental group, specific training in performing the criterion response in the presence of shock. This was not the case for the control group. Thus, a reasonable interpretation of Miller's data is that the difference between his experimental and control groups is solely attributable to this factor. This objection to an adaptation interpretation cannot be raised against the present study.

The Kamin data indicated a greater apparent adaptation effect when the prior shocks were delivered with Bar Present than when with Bar Absent. In suggesting situational specificity as an interpretation, Kamin argued that the absence of the bar during the prior shock phase of the study served to lessen the similarity of the test situation to the training situation. While this is the case, it is also true that the bar's presence during the pre-shock phase provided the animal with practice in the performance of the criterion response in the presence of shock; this is a condition which we have already utilized to interpret Miller's results. The difference between Kamin's two experimental groups could thus also be attributable to this factor. In any event, Kamin's suggestion that a carefully controlled stimulus generalization study could produce a gradient in the apparent adaptation effect has not been borne out.

The perplexing question that remains is why Miller's control group, shocked outside the experimental situation, failed to show any adaptation effect. That it should show less of an effect than that of the experimental group is understandable in terms of lack of practice in the criterion response; but that it should show no effect seems at variance with the general trend of adaptation data. One possibility is that Miller's rats may not have been very highly motivated for food. Unlike the subjects in the present study, they were not reduced in body weight before the experiment, but were merely placed on a 24 hour feeding rhythm. Thus, even though some adaptation to shock may have occurred in the control group, it would not be displayed in performance unless the animals were more motivated for food.

Is The Effect "Adaptation"?

The interpretation of our experimental results must be qualified by a basic reservation as to whether the effect with which we are dealing is, in fact, a form of adaptation. This question has arisen sharply since the recent work of Brimer and Kamin (1961), which was not available at the time this study was designed and performed. Their procedure, basically similar to that of the present study, involved the use of very intense shock (4 ma) during the 10 day "adaptation" phase. This resulted in a very slow subsequent acquisition of the CER, with 1 ma shock as the US. However, the most striking outcome of the Brimer and Kamin study was the almost universal prevalence (28 of 30 animals) of very high supernormal ratios on the first few CER training days. The animals responded to the initial CS presentations by markedly accelerating their bar pressing rates. This phenomenon, it was noted, was closely correlated with a drastic drop in the baseline response rate, produced by experience with intense shock.

This pattern of results suggested the process of Pavlovian disinhibition (Pavlov, 1927). Thus Brimer and Kamin assumed that, when bar pressing rate is inhibited by shock, there is a tendency for novel, extraneous stimuli (e.g., the CS) to "unleash" or "disinhibit" the inhibited behaviour. This interpretation was supported by a follow-up study which involved the training of a new group of rats. These animals were first given intense "adaptation" shock, which severely inhibited their baseline bar pressing. They were then given more bar pressing sessions, without shock and without any CS. These "extra" sessions allowed the baseline rate to recover substantially. When these animals were next given CER training, their performance was indistinguishable from that of normal controls. Thus, when, following prior experience with shock, the baseline rate is allowed to recover, there are no supernormal ratios and no apparent adaptation effect; i.e., as Brimer and Kamin indicate, disinhibition cannot occur if there is no inhibition to be disinhibited!

The authors concluded that, at least in their study, the slow acquisition of the CER by animals which have previously been shocked was a result of a conflict between two opposing tendencies. The first, a tendency to bar press when presented with an extraneous stimulus, is attributable to disinhibition; the second, a tendency to stop bar pressing in response to a CS which precedes shock, is the normal CER phenomenon, increasing in strength with repeated trials. Thus, it is not necessary to postulate that the normal CER tendency is developing at a slower rate than usual; instead it is being counteracted by an opposing tendency. In short, then, it may be that no adaptation - diminished emotional reactivity to shock - is occurring in this situation at all. If this reasoning is correct, variations in the suppression rates are not a reliable index of emotional reactivity in this type of conflict situation.

We must, of course, consider whether this kind of interpretation is applicable to studies such as the present one, which employ weaker prior shock to produce an apparent adaptation effect. We have seen that, in the original Kamin study (1961b), both depressed baselines and supernormal ratios were observed on CER Day 1, though neither tendency was statistically significant.

In the present experiment, the data indicate depressed baselines for the four experimental groups (which show the apparent adaptation effect), but not for the control group (which does not show the effect). While supernormal ratios are not dramatically obvious in the present study, it is of course not necessary that they occur for the above interpretation to be substantially correct; the disinhibiting tendency, after weak shock, may be "subliminal", but still sufficiently strong to counteract the CER tendency.

In this connection, it is interesting to examine the data summarized in Tables III and IV in terms of correlation. Pooling the four experimental groups, we can ask what the relationship is between the tendency for baselines to be lower on Day 1 than on Day P, and the tendency for ratio to be higher on Day 1 than on Day P. The rank order correlation ($N = 27$) is .83, $p < .001$; there is a marked tendency for a lowered baseline to impede the development of low ratios. At the very least, then, the apparent adaptation effect in the present study is associated with lowered baselines. On the other hand, many individual animals without greatly lowered baselines do show slow acquisition of the CER.

These observations suggest, on balance, that one must be very hesitant in viewing the present data as relevant to the problem of adaptation: an interpretation in terms of disinhibition seems at least as plausible. Thus, it may be that this experimental has, unintentionally, involved the study of the situational specificity of a disinhibitory, rather than an adaptation, effect. However, since the study was conceived of in an adaptation framework, we have examined its implications in that light. Certainly, the paradigm is strikingly similar to the adaptation paradigm. The Kamin results (1961b), showing that degree of apparent adaptation varied directly with the intensity of prior shock, are perfectly analagous in form, e.g., to the well known Taylor results (1956) on adaptation of the conditioned eyeblink

We must conclude, finally, that the present results provide no substantial evidence whatever for a situational specificity of adaptation effects. The present study, while open to interpretation in terms other than adaptation, certainly fails to support the notion of situational specificity. The two previous studies which prompted the idea (Miller, 1960; Kamin, 1961b) upon closer examination, are easily susceptible to interpretations in another manner. A more definite answer to the problem would involve utilizing a situation which, like the present study, rules out the possibility of practice at the criterion response during the adaptation phase of the experiment, and which, unlike the present study, utilizes a basic effect which can unambiguously be referred to as adaptation.

CHAPTER FIVE

SUMMARY

The Estes-Skinner conditioned emotional response (CER) was employed to investigate whether an "apparent adaptation effect" reported by Kamin was specific to the situation in which adaptation shock was experienced. The subjects were hooded rats. Four experimental groups received adaptation shocks in four different environments, which were graded in terms of their similarity to the environment in which the CER was subsequently acquired; a control group received no shock before CER training. The four experimental groups acquired the CER significantly more slowly than did the control group, thus replicating Kamin's adaptation effect. There were, however, no differences among the four experimental groups in acquisition of the CER. The data thus provided no evidence for the situational specificity of adaptation effects. However, some aspects of the data suggested that the effect observed may not in fact be attributable to an adaptation process.

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APPENDIX

APPENDIX A

The body of this table contains, for each animal on each day, two numbers. The first of these numbers is the number of bar presses during the four 3-minute intervals immediately preceding CS presentation. The second number is the number of bar presses made during the four CS presentations

	DAYS										
	P	1	2	3	4	5	6	7	8	9	10
Group I											
S 1	89-114	20-42	26-19	65-9	49-11	54-3	64-21	80-3	66-0	33-2	74-3
S 2	85-103	5-11	0-0	20-21	52-5	33-1	42-9	43-3	56-1	54-0	86-6
S 3	186-249	97-126	166-182	344-168	306-60	120-45	207-52	106-56	146-45	94-64	127-35
S 4	83-111	53-50	66-36	87-14	105-25	137-3	110-8	91-15	185-8	110-4	179-11
S 5	86-89	150-123	111-137	176-152	136-97	86-56	175-35	159-5	131-32	108-5	92-17
S 6	143-179	41-116	94-79	85-55	131-54	151-62	41-7	105-13	142-18	150-8	106-7
S 7	124-136	59-69	68-60	75-60	49-3	39-18	35-31	44-33	60-42	48-36	62-48
Group II											
S 1	96-104	30-62	50-40	40-35	43-1	49-0	67-1	58-0	43-0	17-0	54-2
S 2	215-280	205-199	139-106	160-20	114-16	130-6	175-3	127-0	94-2	105-0	136-1
S 3	34-42	1-14	4-8	0-2	1-0	19-2	37-4	56-3	53-0	64-0	105-0
S 4	37-105	29-44	27-36	27-27	41-5	70-0	59-0	43-3	79-20	63-6	87-0
S 5	120-142	25-42	19-58	[illegible]-51	79-54	84-48	142-52	239-22	354-8	215-11	194-3
S 6	27-[illegible]	42-39	50-38	38-28	22-10	59-40	44-6	45-6	37-4	34-3	45-18
S 7	68-70	44-35	15-29	14-35	40-27	115-35	81-3	37-8	63-8	53-13	92-20

APPENDIX A CONTINUED

	DAYS										
	P	1	2	3	4	5	6	7	8	9	10
Group III											
S 1	123-148	75-134	83-74	71-35	41-7	58-4	150-24	110-4	147-16	102-2	125-2
S 2	123-97	6-34	0-8	37-26	19-2	31-8	170-22	56-0	162-6	77-0	160-0
S 3	58-98	0-1	41-47	50-34	21-24	33-32	30-6	49-5	53-14	51-3	48-3
S 4	173-205	98-88	78-60	181-85	122-60	118-49	74-7	99-5	100-9	94-27	86-3
S 5	82-83	68-39	48-56	65-73	47-50	44-16	44-32	57-22	38-29	30-13	42-31
S 6	128-164	36-100	48-95	45-67	133-61	139-26	97-0	72-4	121-2	128-0	150-1
S 7	66-139	68-117	32-59	45-34	104-44	263-48	322-2	210-6	207-1	274-1	223-1
Group IV											
S 1	207-214	123-140	113-81	106-102	243-41	229-8	250-8	157-0	125-4	243-5	50-0
S 2	57-84	95-118	65-67	40-2	123-17	77-27	24-6	17-0	56-2	61-8	42-0
S 3	85-105	46-52	63-55	51-43	61-54	58-62	50-47	35-46	43-28	64-52	18-9
S 4	130-127	35-89	81-48	71-33	2-1	148-54	125-6	87-10	88-12	151-8	80-1
S 5	245-267	98-110	71-36	100-31	181-99	163-70	163-2	136-9	167-1	121-5	71-0
S 6	114-103	82-84	94-40	93-63	117-62	98-60	98-10	88-8	89-22	83-54	82-18
Group C											
S 1	41-64	51-68	69-7	85-0	73-0	55-0	59-3	29-3	36-1	51-15	44-4
S 2	17-16	36-35	33-22	3-1	18-0	17-3	0-1	9-0	13-1	34-7	21-0
S 3	142-126	76-69	129-81	172-1	90-0	196-26	135-1	83-24	154-114	131-79	145-51
S 4	323-314	315-206	138-1	159-0	144-0	376-1	322-1	199-0	220-0	416-1	192-0
S 5	108-98	169-117	130-14	177-9	108-21	127-49	103-48	80-30	121-29	192-23	116-6
S 6	360-451	201-206	83-2	125-0	185-0	134-0	138-1	55-0	73-0	129-0	82-1

APPENDIX B

SUPPRESSION RATIOS

	DAYS										
	P	1	2	3	4	5	6	7	8	9	10
Group I											
S 1	.56	.68	.42	.12	.18	.05	.25	.04	.00	.06	.04
S 2	.55	.69	.60	.51	.09	.03	.18	.07	.02	.00	.07
S 3	.57	.57	.52	.53	.16	.27	.20	.35	.24	.41	.22
S 4	.57	.49	.35	.14	.19	.02	.07	.14	.04	.04	.06
S 5	.51	.45	.55	.46	.41	.39	.17	.03	.20	.04	.16
S 6	.56	.74	.46	.39	.29	.29	.05	.11	.11	.05	.06
S 7	.52	.54	.47	.44	.06	.32	.47	.43	.41	.43	.44
Group II											
S 1	.52	.67	.44	.47	.02	.00	.01	.00	.00	.00	.04
S 2	.57	.49	.43	.11	.12	.04	.02	.00	.02	.00	.01
S 3	.55	.93	.67	1.00	.00	.10	.10	.05	.00	.00	.00
S 4	.65	.60	.57	.50	.11	.00	.00	.07	.20	.09	.00
S 5	.54	.63	.75	.50	.41	.36	.27	.08	.02	.05	.02
S 7	.61	.48	.43	.42	.31	.40	.12	.12	.10	.08	.29
S 7	.51	.44	.66	.71	.40	.23	.04	.18	.11	.20	.18

APPENDIX D CONTINUED

	DAYS										
	P	1	2	3	4	5	6	7	8	9	10
Group III											
S 1	.55	.64	.47	.33	.15	.06	.14	.04	.10	.02	.02
S 2	.44	.85	1.00	.41	.10	.21	.11	.00	.04	.00	.00
S 3	.63	1.00	.53	.40	.53	.49	.17	.09	.21	.06	.06
S 4	.54	.47	.43	.31	.35	.29	.09	.05	.08	.22	.03
S 5	.50	.36	.54	.53	.52	.27	.42	.28	.43	.30	.42
S 6	.56	.74	.66	.60	.31	.16	.00	.05	.02	.00	.01
S 7	.66	.63	.65	.43	.30	.15	.01	.03	.00	.00	.00
Group IV											
S 1	.51	.53	.42	.49	.14	.03	.03	.00	.03	.02	.00
S 2	.60	.55	.51	.05	.12	.26	[illegible]	.00	.05	.12	.00
S 3	.55	.53	.47	.46	.47	.52	[illegible]	.57	.39	.45	.33
S 4	.49	.72	.37	.32	.33	.27	.34	.10	.12	.05	.01
S 5	[illegible]	.53	.34	.24	.35	.30	.01	.06	.01	.04	.00
S 6	.47	.51	.30	.40	.35	.33	.09	.08	.20	.39	.18
Group C											
S 1	.61	.57	.10	.00	.00	.00	.05	.09	.03	.25	.08
S 2	.48	.49	.40	.25	.00	.15	1.00	.00	.07	.17	.00
S 3	[illegible]	.48	.39	.01	.00	.12	.01	.22	.43	.38	.26
S 4	.49	.40	.01	.00	.00	.00	.00	.00	.00	.00	.00
S 5	.48	.41	.10	.05	.16	.38	.32	.27	.19	.11	.05
S 6	.56	.51	.02	.00	.00	.00	.01	.00	.00	.00	.01