# EFFECTS OF RE-EXPOSURES

# TO

# COMPONENTS OF AN EARLY FEAR CONDITIONING SITUATION.

by

CAROL SOLYOM

A Thesis

Submitted to the Faculty of Graduate Studies

in Partial Fulfillment of the Requirements

for the Degree

Master of Arts

Sir George Williams University

September 1969

# EFFECTS OF RE-EXPOSURES

# TO

# COMPONENTS OF AN EARLY FEAR CONDITIONING SITUATION.

CAROL SOLYOM

# EFFECTS OF RE-EXPOSURES TO COMPONENTS OF AN EARLY FEAR CONDITIONING SITUATION

An experiment on weanling rats was conducted to ascertain the effects of re-exposures to some components of the original stimulus complex on the retention of fear learned in an aversive conditioning paradigm. Re-exposure to the conditioned stimulus plus reinforcement ($S_1$+ US) effected the greatest amount of retention. Re-exposures to the unreinforced conditioned stimulus alone ($S_1$) also seemed to be effective in maintaining fear but the effect of re-exposures to the unconditioned stimulus in a different situation ($S_2$+ US) was obscure. Retention of the conditioned fear was not observed in non-re-exposed rats. The adequacy of the avoidance response as a measure of fear in this situation was discussed. An interpretation of the data in terms of extinction and interruption of "forgetting" was attempted.

ACKNOWLEDGEMENTS

The author would like to express her indebtedness to Dr. A. Hilton for his support and guidance during all phases of this research.

The encouragement and assistance of other faculty members, in particular Dr. J. Stewart, were also invaluable, as was the technical advice given by Mr. G. Burrows.

The research was supported, in part, by a National Research Council Grant No. AP 310 to Dr. A. Hilton.

TABLE OF CONTENTS

# I. INTRODUCTION

The present thesis investigated the effect of spaced re-exposures to stimulus components of a fear conditioning situation on retention of a learned fear in young rats. It derived initially from an interest in the etiology of phobias occurring in adulthood — mal-adaptive fears which compel the individual to avoid the feared object or situation (Marks and Gelder, 1965; Masserman, 1946; Sim and Houghton, 1966). Phobias frequently resemble the common fears of childhood and the specific phobias in particular seem to be acquired in childhood (Marks and Gelder, 1966). It was, therefore, postulated that these phobias might have their origin in childhood fears. The fear may have lain dormant, coming to the fore in adulthood only when a stressful situation was encountered. Indeed, some animal studies have shown that an earlier learned avoidance response may recur during the course of experimental neurosis induced by a conflict situation (Fonberg, 1958; Petrova, 1947).

One mechanism by which such fears could remain potentially active was suggested by Campbell and Jaynes'(1966) concept of "reinstatement." They defined reinstatement as "a small amount of partial practice or repetition of an experience over the developmental period which is enough to maintain an early learned response at a high level, but is not enough to produce any effect in animals which have not had the early experience." The effect of "reinstatement" was demonstrated in a simple fear conditioning experiment.

Twenty-five day old rats were subjected to two 5-minute periods of 15 massed and inescapable shocks in the black compartment of a divided shuttle-box. These sessions were alternated with two 5-minute periods in a white compartment, without shock. Fear conditioning was followed 7, 14 and 21 days later by a one-shock retraining session, the "reinstatement", a procedure "precisely the same as the training procedure, except that only 1 instead of 30 shocks was administered." During testing, one week after the last session, the rats demonstrated a high level of fear retention by avoiding the black compartment for most of the testing hour. When fear conditioning was followed by three brief exposures to the training apparatus without shock, or when the one-shock training sessions were not preceded by fear conditioning, no retention of fear was observed during testing.

This "reinstatement" experiment has been replicated by Shubat and Whitehouse (1968). They added a fourth, experimentally naive group that was given only the one-hour free-responding test at 53 days of age to determine which compartment Ss preferred. The one-shock training sessions were found to be even more effective than they had been in Campbell and Jaynes' (1966) study in maintaining fear in the previously fear conditioned group and were again ineffective when given alone. The experimentally naive group showed a strong preference for the black compartment. Contrary to the finding of Campbell and

Jaynes (1966), the group which received the fear conditioning followed by three brief exposures to the training apparatus without shock also demonstrated some retention of fear. These Ss avoided the black compartment significantly more than the other control groups, although they avoided less than Ss who had received the one-shock retraining sessions. The authors attributed the differences between the two studies to differences in shock source and shock level, the latter being much higher in the Shubat and Whitehouse (1968) experiment. These brief exposure sessions, however, might have served as reminders of the early experience.

Campbell and Jaynes (1966) felt that a similarity existed between their "reinstatement" and the "reinstatement" that might occur verbally among humans as when a child is reminded of a previous event or feeling. However, if such verbal reminders are generally not followed by any unconditioned stimulus (US), a more apt analogue of a verbal reminder might be the procedure of re-exposing S to the training apparatus without the shock. In the absence of a control group in either the Campbell and Jaynes (1966) or Shubat and Whitehouse (1968) studies which received the early fear conditioning alone, an assessment of the effect of post-fear conditioning exposures to the unreinforced conditioned stimulus (CS) was not possible.

One can argue that presentations of the unreinforced CS should lead to extinction, i.e. a decrement in response strength, rather than to a maintenance of the learned response. Again, to assess any decrement in the number of responses an appropriate control for the retention of the original fear without re-exposure to the CS and/or US is needed.

The experiment to be reported was concerned with a further exploration of the "reinstatement" paradigm.

(1) Can exposures other than additional conditioning trials (the "reinstatements") bring about a demonstration of the Campbell and Jaynes' (1966)"reinstatement effect", i.e. greater retention of fear than that obtained after only the early fear conditioning ?

(2) Will three exposures to the unreinforced CS after early fear conditioning bring about a "reinstatement effect" or an "extinction effect" or will they have no effect upon retention of fear ?

(3) What are the consequences of exposures to the US in a different situation after early fear conditioning ?

## II. METHOD

### Subjects

Ss were 59 hooded male rats from the Quebec Breeding Farms. Of the six groups in the experiment, Ss in Groups 1–5 were received in the laboratory when they were 22 days old and were randomly assigned to five groups with 10 Ss in four groups and nine in one group (Group 5). The 10 Ss in Group 6 were received at 50 days of age, three days prior to testing. All Ss were housed in group cages for the duration of the experiment.

### Apparatus

There were two fear conditioning units ($S_1$ and $S_2$) used in the experiment. $S_1$ was a plexiglass shuttle-box (Lehigh Valley Model 146-04) with a grid floor. It was modified by inserting black cardboard walls into the shock compartment and white cardboard walls and floor into the "safe" compartment. A metal barrier, painted to match the respective compartments, divided the shuttle-box throughout the training sessions but was removed prior to testing to permit S to move back and forth freely from one compartment to the other. The toggle floor was connected to two timers; one, activated when S was placed in the black compartment, recorded time in the apparatus; the other recorded time S spent in the white compartment.

The aversive US was a 2-second 0.8 mA constant current ac foot shock. The intensity of the shock was roughly the same magnitude

as that used by Campbell and Jaynes (1966 - cf. Appendix I). Shock source was a shock generator (Grason-Stadler Model E1064GS) with an internal grid scrambler, programmed to administer the shock on a 20-second variable interval schedule.

The second apparatus, $S_2$, was a plexiglass Skinner box (Grason-Stadler Model E3125B-100) with a grid floor. It was connected to the same shock generator as the shuttle-box so that the shock administered would be nearly identical to that given during the fear conditioning.

The experiment was conducted in a small room, illuminated by a 60-watt shaded lamp placed behind and above the apparatus to permit observation of S's behavior. A white noise generator (Grason-Stadler Model 901B)with the speech noise channel set at -15dB delivered white noise throughout all phases of the experiment.

Procedure

The training procedure for each group is schematized in Table 1. All Ss were 25 days of age on experimental Day 1 and 53 days of age at testing, on Day 29.

On Day 1, Ss in Group 1 (Fear; $S_1$+ US) were subjected to fear conditioning. The fear conditioning consisted of placing S in the black compartment of the shuttle-box and administering fifteen 2-second 0.8 mA foot shocks on a 20-second variable interval schedule over a 5-minute period. S was then transferred to the

TABLE 1

SUMMARY OF EXPERIMENTAL DESIGN

| Group | Training Program | | |
|---|---|---|---|
| | Day 1 | Days 8,15,22 | ..Day 29 |
| 1 (Fear; $S_1$+ US) | Fear conditioning | $S_1$+ US | Testing |
| 2 (Fear; $S_1$) | Fear conditioning | $S_1$ | Testing |
| 3 (Fear; $S_2$+ US) | Fear conditioning | $S_2$+ US | Testing |
| 4 (Fear only) | Fear conditioning | No training | Testing |
| 5($S_1$; $S_1$+ US) | Apparatus exposure | $S_1$+ US | Testing |
| 6 (Naive) | No training | No training | Testing |

white, "safe" compartment for a 5-minute shock-free period. The entire procedure was immediately repeated so that S had a total of 30 shocks in a 20-minute training session. S was then returned to its home cage. Fear conditioning was followed 7, 14, and 21 days later by one-shock retraining sessions. S was placed in the black compartment for one minute, at the end of which it received one 2-second 0.8 mA foot shock. S was immediately transferred to the white compartment for a one-minute period and then taken to its home cage. On Day 15, S was first placed in the white, "safe" compartment and then in the black compartment.

On Day 1, Ss in Group 2 (Fear; $S_1$) were subjected to the same fear conditioning as Ss in Group 1. On Days 8, 15, and 22, each S was re-exposed to $S_1$ in the same manner as Group 1 Ss, but did not receive shock.

Ss in Group 3 (Fear; $S_2$+ US) had the same fear conditioning on Day 1 as Groups 1 and 2. On Days 8,15, and 22, each S received one 2-second 0.8 mA foot shock at the end of a 1-minute period in $S_2$ (the Skinner box). Immediately after the shock was administered, S was returned to his home cage.

Each S in Group 4 (Fear only) was subjected to the same fear conditioning on Day 1 as Ss in Groups 1, 2, and 3. No further training was given.

On Day 1, Ss in Group 5 ($S_1$; $S_1$+ US) were placed in $S_1$ in the same manner as the fear conditioned Ss but did not

receive shock. On Days 8, 15, and 22 S received the same one-shock training sessions as Ss in Group 1.

Ss in Group 6 (Naive) received no training — they had neither the fear conditioning nor any other exposures to $S_1$ or $S_2$ prior to testing.

Testing for the effects of the various treatments took place on Day 29. Each S of each group was placed in the black compartment of $S_1$, with the centre barrier removed, for a 60-minute free-responding period. The amount of time S spent in the white, "safe" compartment, as measured by the timer, was recorded in five 12-minute blocks and served as a measure of fear. A less accurate measure of initial freezing (complete immobility of S, no head movements, no sniffing, etc.) when S was placed in the apparatus was recorded by E who noted the time of offset of freezing on the continuously operating timer.

Days and hours of training and testing sessions were counterbalanced over groups in a replicated Latin Square design. Two Ss from each group were given training on each day and the hour of training was systematically varied from day to day.

During the weekly intervals between fear conditioning, retraining sessions, and testing, Ss were maintained in their home cages and given minimal handling. They were placed in a group in an open activity area for one-half hour, twice weekly.

## III. RESULTS

The general pattern of results apparent in Figure 1 is that all groups but Group 1 (Fear; $S_1$+ US) spent less than 50% of the test hour in the white, "safe" compartment. An overall analysis of variance indicated a significant treatment effect (Kruskal-Wallis, $p < .02$). Group 1 which received the early fear conditioning followed by three brief retraining sessions spent a mean of 67% of the test hour in the white compartment. The difference between Group 1 and all other groups was statistically significant ($p = .003$, Mann-Whitney U test, two-tailed).

Group 2 (Fear; $S_1$) which received the early fear conditioning followed by three brief exposures to the CS alone spent a mean of 35% of the test hour in the white compartment. This performance was significantly different from that of Group 4 (Fear only) ($p = .01$, Mann-Whitney U test, two-tailed) and Group 6 (Naive) ( $p = .006$, Mann-Whitney U test, two-tailed). There were no other statistically significant differences.

The within-group distribution of S's preference for the white compartment is illustrated in Figure 2.

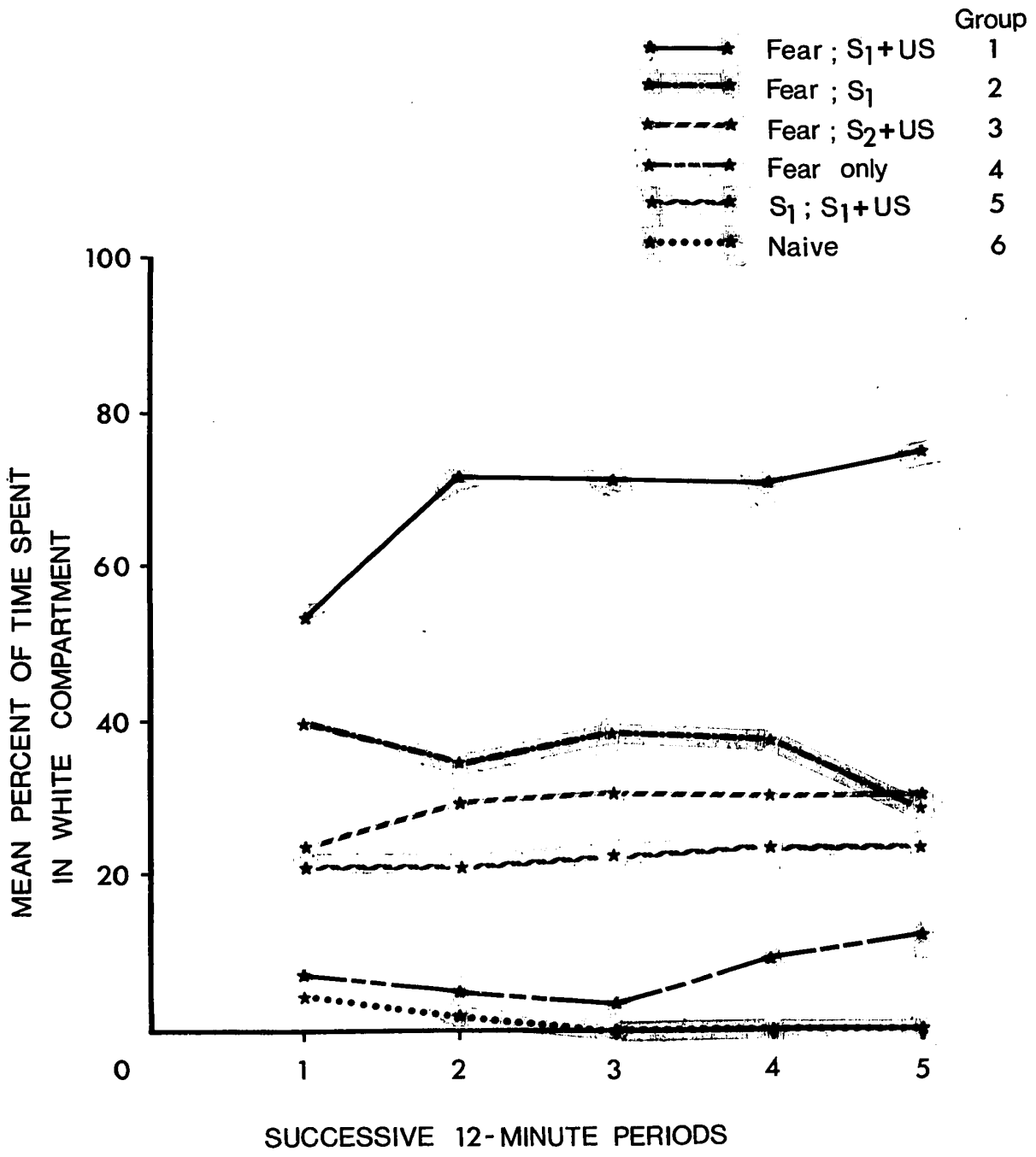


FIG. 1 Mean group preferences for white ("safe") compartment during testing.

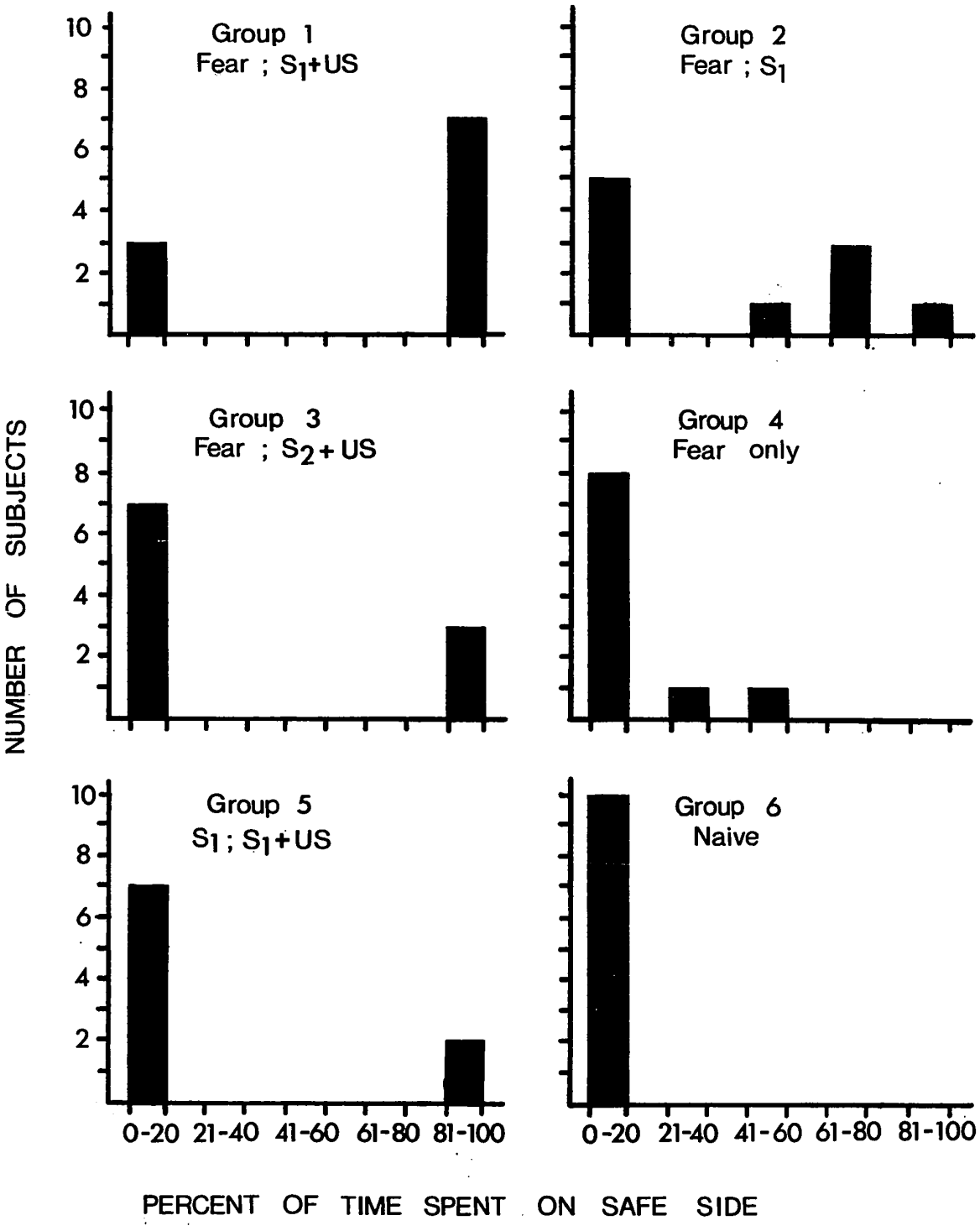


FIG. 2 Distribution of subjects in each group according to per cent time spent in white compartment during testing.

For the three groups which received one-shock sessions on Days 8, 15, and 22 (Groups 1, 3 and 5), the distribution is bimodal. In Group 1 (Fear; $S_1$+ US), seven Ss spent between 80-100% of their time in the white compartment, while three Ss spent less than 20% of their time there. The opposite trend was observed in Groups 3 (Fear; $S_2$+ US) and 5 ($S_1$; $S_1$+ US): seven Ss in each group spent less than 20% of their time in the white compartment, the remainder spent between 80-100% of their time there. A slight trend towards a bimodal distribution is also apparent in Group 2 (Fear; $S_1$): half the Ss in Group 2 spent less than 20% of their time in the white compartment, the other half spent between 41-100% of their time there.

In all groups there was at least one S which responded with freezing to placement in the black compartment at the beginning of the test hour. Table 2 presents the number of Ss freezing in each group and the duration of the freezing response. There was no regular pattern of freezing from group to group with no significant differences and no pattern that seemed directly related to the pattern of preferences for the white compartment.

TABLE 2

FREEZING BEHAVIOUR ON INTRODUCTION TO TEST SITUATION

| Group | | number of Ss | Duration of Freezing (min.) mean | range |
|---|---|---|---|---|
| 1 | freezing | 4 | 6.5 | 4.5–12.0 |
| | no freezing | 6 | .. | .. |
| 2 | freezing | 1 | (4.0) | (4.0) |
| | no freezing | 9 | .. | .. |
| 3 | freezing | 7 | 8.0 | 3.0–16.0 |
| | no freezing | 3 | .. | .. |
| 4 | freezing | 10 | 4.4 | 1.5–15.0 |
| | no freezing | 0 | .. | .. |
| 5 | freezing | 5 | 5.7 | 2.0–10.0 |
| | no freezing | 4 | .. | .. |
| 6 | freezing | 10 | 4.5 | 2.0–10.0 |

## IV. DISCUSSION

In the present study, avoidance of the black compartment during testing was used as the measure of fear retained in order to make direct comparisons with the results of the previous studies on "reinstatement" (Campbell and Jaynes, 1966; Shubat and Whitehouse, 1968). The measure, frequency of freezing, used in the present study provided an additional indicator of fear and suggests that the manifestation of fear may be multiform. However, while both avoidance and freezing responses may be expressions of the conditioned fear, the latter may also be a response to the novelty of the situation (unconditioned fear) and its interpretation is, therefore, ambiguous.

As anticipated from the prior "reinstatement" studies (Campbell and Jaynes, 1966; Shubat and Whitehouse, 1968), one-shock retraining sessions were found to be capable of maintaining a preference for a "safe" compartment which, in Ss subjected to the early fear conditioning only, disappeared over time. The most interesting and somewhat surprising finding, however, was an apparent retention of the preference in the group re-exposed to the CS alone (Group 2). Although the degree of retention of the preference in this group was below that of Group 1 (Fear; $S_1$+ US), it was significantly greater than that of Group 4 (Fear only). Group 4 showed no evidence of retention of this preference. In a

recent "reinstatement" experiment, Rohrbaugh and Riccio (1968) independently found an almost identical effect of short duration (30-second and 60-second) CS only exposures after the early fear conditioning and no evidence of fear retention in a non-re-exposed group.

The significantly greater retention of apparent fear in Group 1 seems to indicate that additional reinforced trials ($S_1$+US) increased response strength. This would be in accordance with traditional conditioning theories. That presentations of unreinforced trials also seemed to increase response strength would not seem to be in accordance with traditional conditioning theories. The reliability of this result, however, is underlined by the almost identical findings of Rohrbaugh and Riccio (1968) and Shubat and Whitehouse (1968) under very similar experimental conditions.

In attempting to resolve the apparent contradiction between the observed effect of the unreinforced CS and that postulated by traditional conditioning theories, the following hypotheses were considered. The "reinstatement" effect might involve (1) interruption of forgetting; (2) incubation of fear (Eysenck, 1968); (3) increased arousal due to sensitization by early fear conditioning (Lader and Mathews, 1968); and (4) a rivalry between the processes of extinction and "spontaneous recovery."

Since retention of fear was not observed in Group 4 (Fear only) it may be assumed that, in the early stages of a rat's development, forgetting of a conditioned fear response occurs quite rapidly. Campbell and Campbell (1962) reported that rats fear-conditioned at 23 days of age retained the fear response for at least seven days but not for 21 days. Since, in this study, the brief re-exposures to CS alone were given seven days after the fear conditioning, one may assume that a re-experience of fear may have counteracted the forgetting. Effective "reinstatement" of fear would, thus seem to be in part dependent upon the interval between fear conditioning and re-exposure trials. If forgetting is almost completed when the unreinforced CS is presented, one might expect retention of the fear response to be little affected by such "reinstatement." Further experimentation could possibly clarify this point.

An alternative explanation for the effect of the CS only exposures may be found in the incubation of anxiety/fear responses theory proposed by Eysenck (1968). He postulated that a classically conditioned fear is itself a painful event, and the stimuli associated with it (i.e., CS) come to evoke more fear by classical conditioning, but without the original US being employed. Hence, the presentation of an unreinforced CS may provoke an increment in response strength as well as

a decrement in response strength and the observed CR will be the resultant of two opposing tendencies. If incrementing tendencies are greater than decrementing ones, "incubation" will be observed; if decrementing tendencies are greater than incrementing ones, "extinction" will be observed. It would seem that the observed effect of the "reinstatement" given to Group 2 in the present experiment might have involved a conflict between incrementing and decrementing tendencies, e.g. extinction, relearning, spontaneous recovery, the relative contributions of which are unknown.

A physiological model of the mechanisms underlying the observed effect of the unreinforced CS has been put forward by Lader and Mathews (1968). This model, based in part upon the experimental finding that rate of habituation was inversely related to arousal level, proposed that the effect of repeated stimulus presentations is dependent upon the ongoing level of arousal:

> It was postulated that if the level of arousal at any moment is low, the intrusion of a repetitive or continuing stimulus would have only a transitory effect in raising the level of arousal further and the ensuing habituation would be rapid.... However, if the ongoing level of arousal is high, habituation would be slow, especially at first.

With this model it can be seen that a critical level

> of arousal would be predicted above which a repetitive stimulus would not be accompanied by any habituation; instead the level of arousal would become higher with each successive stimulus producing a "positive feedback" mechanism(p.412).

Although the effect of early traumatic experiences on later behaviour seems to be still in dispute, May (1967) concluded that early traumatic experiences led to increased emotionality in rats. Therefore, it might be assumed that the early fear conditioning in the present experiment led to heightened arousal. The observed retention of fear in Group 2 could then have been due to retarded habituation to the unreinforced CS, to which S had become sensitized.

If a CS is repeatedly presented without the usual reinforcer, the conditioned response generally undergoes a progressive decrement called "extinction" (Kimble, 1961, p. 281) for which some theorists have invoked the concept of "inhibition." During a period of rest following extinction trials the extinguished response undergoes "spontaneous recovery" possibly due to a dissipation of inhibition (Kimble, 1961, p. 284). Since the observed effect of presentations of the unreinforced CS in this study was an increase and not a decrement in response strength, it might be hypothesized that the process of extinction was counterbalanced by the process of "spontaneous recovery." Because

the duration of the unreinforced CS was relatively short (60 seconds), the intertrial interval was long (7 days), and there were only three trials, minimal inhibition may have been dissipated prior to each subsequent session and consequently may not have developed sufficiently to bring about an observable response decrement.

Some support for assuming an interaction between the processes of extinction and "spontaneous recovery" may be found in the "reinstatement" experiment of Rohrbaugh and Riccio (1968). They found that the enhancement of the fear response observed following 30-second and 60-second exposures to the unreinforced CS was not evident following 300-second exposures. Thus, it would seem that a longer exposure time plus a shorter intertrial interval (4 days) might permit a strengthening of inhibition to the point that extinction is manifested. Extinction might also be observed if the number of CS exposures was increased, e.g., 6, 12 or 24, allowing inhibition to build up over time.

An interpretation of the bimodality of scores in Groups 1, 3, and 5 would seem to be partly dependent upon the competing fear responses of avoidance and freezing. Avoidance of the black shock compartment by fear-conditioned Ss would seem to indicate retention of the conditioned fear, since the experimentally naive group in this and other similar

studies (Campbell and Campbell, 1962; Shubat and Whitehouse, 1968) demonstrated a strong preference for the black compartment. Freezing, however, may arise in response either to the conditioned fear or to unconditioned fear (novelty) and, in this experiment, there was no way to ascertain which interpretation was applicable. If S froze because of conditioned fear, the period of freezing might have led to extinction of the fear response, as S was made aware that the aversive stimulus was not forthcoming. If this was so, S would not be expected to subsequently avoid the black compartment.

Alternating placement in the black and white compartments at the start of testing might also clarify the nature of the freezing response: e.g., if the freezing response was elicited by the novelty of the situation, it might be expected that S would move from the white to the preferred black compartment once the novelty wore off. On the other hand, if there was retention of the conditioned fear, S might be expected to remain where it was placed.

The bimodal distribution may also be a consequence of individual variation in the acquisition and retention of fear responses. Again, the work of Lader and his coworkers (Lader, 1967; Lader and Mathews, 1968; Lader and Wing, 1966) on the psychophysiological aspects of anxiety in humans suggests that the ongoing level of arousal might be the determining factor

in perceiving a stimulus as fearful and in determining which response will occur. A stressful stimulus presented to one individual will increase arousal beyond the critical level so that habituation to that stimulus will be slow or absent; while in another individual an initial response not exceeding the critical level will not prevent the normal process of habituation.

Investigations of the development of experimental neurosis have reported a different rate of development in different Ss (Pavlov, 1927), and a different type of response to the same stress (Masserman, 1943, p.67-71)— some animals will escape from the situation, others will freeze. These assumptions of varying thresholds for a fear response and for the type of response elicited might explain the all-or-none pattern of results found within some of the groups. In other words, not all Ss necessarily reacted with fear to the fear conditioning and among those who did, some escaped from the situation, others froze.

The relevance of the findings to the etiology of phobias is unclear. The development of a phobia seems to be dependent upon a number of factors—temperament, intensity of the initial response, frequency of repetition of the experience —but if these are held constant, some form of

"reinstatement", particularly the CS alone exposures, may be of importance. It would be tempting to suggest that the commonly occurring phobias are those which are frequently "reinstated" from childhood on, e.g., social phobias, street phobias, etc. The situation, however, is not yet clear. There are many phobias, e.g., plane phobias, which exist despite the individual never having experienced the phobogenic situation or where "reinstatement" was consistently avoided. The propensity of humans to rehearse fear, even in the absence of external fear-provoking stimuli, and the difficulty in escaping verbal reminders of the feared object, may be responsible for the maintenance of a fear response, but a parallel between these reminders and the"reinstatement" of the animal experiments does not seem warranted without further exploration.

REFERENCES

Campbell, B.A. and Campbell, E.H. Retention and extinction of learned fear in infant and adult rats. Journal of Comparative and Physiological Psychology, 1962, 55, 1-8.

Campbell, B.A. and Jaynes, J. Reinstatement. Psychological Review, 1966, 73, 478-480.

Campbell, B.A. and Teghtsoonian, R. Electrical and behavioral effects of different types of shock stimuli on the rat. Journal of Comparative and Physiological Psychology, 1958, 51, 185-192.

Cooke, N.M. (Ed.) Allied electronics data handbook, Chicago: Allied Radio Corporation, 1963.

Eysenck, H.J. A theory of the incubation of anxiety/fear responses. Behavior Research and Therapy, 1968, 6, 309-321.

Fonberg, E. The manifestations of the defensive reactions in neurotic states. Acta Biologica Experimentalis, 1958, 18, 89-116.

Kimble, G.A. Hilgard and Marquis' Conditioning and learning. New York: Appleton-Century-Crofts, 1961.

Lader, M.H. Palmar conductance measures in anxiety and phobic states. Journal of Psychosomatic Research, 1967, 11, 271-281.

Lader, M.H. and Mathews, A.M. A physiological model of phobic anxiety and desensitization. Behavior Research and Therapy, 1968, 6, 411-421.

Lader, M.H. and Wing, L. Physiological measures, sedative drugs, and morbid anxiety. London, Oxford University Press, 1966.

Marks, I.M. and Gelder, M.G. A controlled retrospective study of behavior therapy in phobic patients. British Journal of Psychiatry, 1965, 111, 561-573.

Marks, I.M. and Gelder, M.G. Different ages of onset in varieties of phobia. American Journal of Psychiatry, 1966, 123, 218-221.

Masserman, J.H. Behavior and neurosis. Chicago; University of Chicago Press, 1943.

Masserman, J.H. Dynamic principles of psychiatry. Philadelphia; Saunders, 1946.

May, J.G. The effects of infantile experience on later emotionality and sensory discrimination. Psychonomic Science, 1967, 9, 29-30.

Pavlov, I.P. Conditioned reflexes (Translated by G.V. Anrep), London: Oxford University Press, 1927.

Petrova, M. Experimental phobia. American Review of Soviet Medicine, 1947-48, 5, 115.

Rohrbaugh, M. and Riccio, D.C. Paradoxical enhancement of learned fear. Paper presented at the meeting of the Psychonomic Society, St. Louis, 1968.

Shubat, E.E. and Whitehouse, J.M. Reinstatement: An attempt at replication. Psychonomic Science, 1968, 12, 215-216.

Sim, M. and Houghton, H. Phobic anxiety and its treatment. The Journal of Nervous and Mental Diseases, 1966, 143, 484-491.

# APPENDICES

# APPENDIX I

# DERIVATION OF SHOCK INTENSITY

## Derivation of Shock Intensity

Choice of shock level was partly dictated by the restrictions of the laboratory — only a constant current shock source was available — and partly on the analysis by Shubat and Whitehouse (1968) indicating that a 1 mA shock was considerably higher than the 170 V matched impedance shock of Campbell and Jaynes (1966). In order to eliminate differences possibly attributable to the different shock level, an attempt was made to replicate, as closely as possible, the shock level of the original reinstatement experiment (Campbell and Jaynes, 1966).

On a common logarithmic scale (cf. Campbell and Teghtsoonian, 1958; Shubat and Whitehouse, 1968), 1 mA is equivalent to 24 dB above the 0 level and 170 V matched impedance shock is 15 dB above the 0 level. A 9 dB difference in a negative direction, according to a power ratio versus dB table (Cooke, 1963), gives a ratio of 0.1259. Subtracting this ratio from 1.0000, then multiplying by 1 mA yields 0.8741 mA. Because the Grason-Stadler shock generator permitted a selection only between 1 mA and 0.8 mA, the latter was chosen as being closer to the desired shock level.

# APPENDIX II

## ABSOLUTE AND PERCENTAGE VALUES OF TIME SPENT IN WHITE COMPARTMENT

Absolute and Percentage Values of Time Spent in White Compartment

| Subject | Groups | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| | Absolute Values (secs) | | | | | |
| 1 | 3203 | 72 | 0 | 4 | 0 | 0 |
| 2 | 3592 | 287 | 0 | 0 | 0 | 32 |
| 3 | 0 | 52 | 3094 | 2 | 3542 | 42 |
| 4 | 2971 | 0 | 0 | 959 | 0 | 22 |
| 5 | 37 | 2513 | 3533 | 10 | 39 | 29 |
| 6 | 3508 | 1595 | 23 | 46 | 3553 | 13 |
| 7 | 3568 | 2514 | 0 | 9 | 0 | 361 |
| 8 | 3533 | 2938 | 0 | 0 | 23 | 6 |
| 9 | 281 | 2418 | 47 | 1601 | 0 | 3 |
| 10 | 3508 | 337 | 3582 | 18 | .. | 10 |
| | Percentage Values | | | | | |
| 1 | 88.97 | 2.00 | 0.00 | 0.11 | 00 | 0.00 |
| 2 | 99.78 | 7.97 | 0.00 | 0.00 | 0.00 | 0.89 |
| 3 | 0.00 | 1.44 | 85.94 | 0.06 | 98.38 | 1.17 |
| 4 | 82.53 | 0.00 | 0.00 | 26.64 | 0.00 | 0.61 |
| 5 | 1.03 | 69.81 | 98.14 | 0.28 | 1.08 | 0.81 |
| 6 | 97.44 | 44.30 | 0.64 | 1.28 | 98.69 | 0.36 |
| 7 | 99.11 | 69.83 | 0.00 | 0.25 | 0.00 | 10.03 |
| 8 | 98.14 | 81.61 | 0.00 | 0.00 | 0.64 | 0.16 |
| 9 | 7.81 | 67.16 | 1.31 | 44.47 | 0.00 | 0.08 |
| 10 | 97.44 | 9.36 | 99.50 | 0.50 | .. | 0.28 |

# APPENDIX III

## DURATION OF FREEZING ON INTRODUCTION OF SUBJECT TO TEST SITUATION

Duration of Freezing on Introduction of Subject to Test Situation

| Subject | Freezing Time (min.) | | | | | |
|---|---|---|---|---|---|---|
| | Groups | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | 5.00 | 00.00 | 16.00 | 5.50 | 5.50 | 10.00 |
| 2 | 0.00 | 0.00 | 9.00 | 8.00 | 8.00 | 2.50 |
| 3 | 4.50 | 0.00 | 4.00 | 8.00 | 0.00 | 3.50 |
| 4 | 4.50 | 4.00 | 10.00 | 1.50 | 0.00 | 2.00 |
| 5 | 12.00 | 0.00 | 0.00 | 4.00 | 0.00 | 4.00 |
| 6 | 0.00 | 0.00 | 6.00 | 2.00 | 0.00 | 5.50 |
| 7 | 0.00 | 0.00 | 8.00 | 3.00 | 2.00 | 2.00 |
| 8 | 0.00 | 0.00 | 3.00 | 15.00 | 10.00 | 5.00 |
| 9 | 0.00 | 0.00 | 0.00 | 3.00 | 3.00 | 7.00 |
| 10 | 0.00 | 0.00 | 0.00 | 1.50 | .. | 3.50 |