ANXIETY AND THE LATENCY OF THE CONDITIONED FEAR RESPONSE

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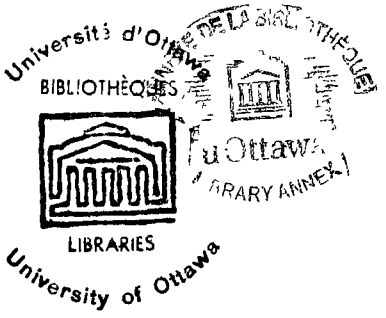

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CURRICULUM STUDIORUM

David R. Evans was born on January 30, 1940, in Birmingham, England. He received the Bachelor of Arts degree from the University of Toronto, in 1962.

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INTRODUCTION

In an earlier study, it was found that the latency of the conditioned fear response was probably of the order of 3.5 seconds. This hypothesis could not be accepted because of a dichotomy in response among subjects at the critical latency. The investigator accounted for the dichotomy by postulating the level of manifest anxiety or drive was responsible for the confounded result. The present study is an attempt to replicate the earlier study controlling for level of anxiety.

Three important concepts in this study are operationally defined at this point. The origins of these definitions will be discussed at greater length in Chapter I. The fear response is defined as the subject's response to a tone, which has been paired with shock on several previous trials. The latency of the fear response is defined as the time between the onset of the tone and the effect of the fear response on a reaction time task. Anxiety is defined as that which is measured by the Manifest Anxiety Scale.

The conditioned fear response has been used extensively in experimental psychology. More recently it has been used in behaviour therapy, and in assessing the action of drugs. Knowledge of the latency of the conditioned fear response and variables affecting this latency are important to the theory behind each of these important areas. It is submitted then, that investigation of anxiety and the latency of the conditioned

fear response is important, not only for its academic interest, but also because of its relationship to these other important areas.

The first section of this thesis deals with earlier work on the latency of the fear response. Three topics branching from this work, fear, anxiety, and the probe stimulus technique are further discussed. The effect of anxiety on the fear response and in turn the probe stimulus response is discussed and two hypotheses are postulated.

The second section is concerned with the method employed to test these hypotheses. In this section the major topics discussed are the subjects and their selection, the apparatus, the procedure, and the null hypotheses and their analysis.

The succeeding and final chapters deal with the presentation and discussion of the results of the experiment. The results are discussed in terms of the theory outlined in the first chapter and their implications are considered.

CHAPTER I

REVIEW OF THE LITERATURE

The problem to be investigated in this study is the influence of two extreme levels of anxiety on the latency of the conditioned fear response. In a recent study, Champion[1] postulates that level of anxiety was responsible for a divergence of response latency to conditioned fear. The concepts of fear and anxiety are outlined as they relate to the problem. The theory, which suggests the relation between anxiety level and performance in conditioning, is considered. Two research hypotheses were formulated with these considerations in mind.

1. Origins of the Problem.

It is Champion's[2] opinion that information concerning the fear response is of paramount importance to psychology, because of its place in behaviour theory and abnormal psychology. He considers that fear is the result of classical aversive conditioning, and therefore the principles of learning may be applied to its acquisition and extinction. In a discussion of

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1 R.A. Champion, "The Latency of the Conditioned Fear Response", American Journal of Psychology, Vol. 77, No. 1, issue of March 1964, p. 75-83.

2 --------, "The Acquisition and Extinction of the Fear Response", Australian Journal of Psychology, Vol. 13, No. 1, issue of 1961, p. 23-28.

factors affecting the acquisition of fear he noted that theories to date have been based on the assumption that the fear response is of short latency in the order of 0.5 seconds. He reported two studies that indicate that fear has a latency between 0.5 and 4.5 seconds. The importance of the latency of the fear response to current learning theory provoked him to investigate this variable.

To explain opposite response latencies among his subjects he suggests that different levels of anxiety may have caused the dichotomous results. In his study, forty-four subjects were conditioned to respond with a fear response to a tone after the tone had been paired with shock for nineteen trials. The probe stimulus technique, to be described below, was used to measure the latency of the conditioned fear response. Among his subjects he found two groups of subjects who reacted in opposite directions, as indicated by their probe stimulus response latencies. This result confounded his main result, such that he felt that a study to investigate the effects of anxiety upon the latency of the fear response should be done before further conclusions were made. It was decided that this problem would form an excellent area of research and a necessary addition to the work of Champion.

2. Fear.

It is important before proceeding further to clarify the current theory and definition of the various variables involved in this study. In this section the concept fear will be discussed and in the following section the concept anxiety will be considered. Following a discussion of each concept the method of measurement to be employed with each variable will be outlined.

Fear is defined as a learned, anticipatory response to painful stimulation. This definition is offered by many authors in the present literature, viz., Brown and Jacobs,[3] Kalish,[4] and Mowrer and Aiken.[5] This definition is also consistent with the definition, about which Champion[6] centers his discussion. The usual procedure, by which fear is learned or conditioned, is to present the subject with a conditioned stimulus (CS), a neutral stimulus, and an unconditioned stimulus (UCS), a noxious

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3 Judson S. Brown and Alfred Jacobs, "The Role of Fear in the Motivation and Acquisition of Responses", Journal of Experimental Psychology, Vol. 39, No. 6, issue of December 1949, p. 747-759.

4 Harry I. Kalish, 'Strength of Fear as a Function of Acquisition and Extinction Trials", Journal of Experimental Psychology, Vol. 47, No. 1, issue of January 1954, p. 1-9.

5 O.H. Mowrer and E.G. Aiken, "Contiguity vs. Drive Reduction in Conditioned Fear: Temporal Variations in Conditioned and Unconditioned Stimulus", American Journal of Psychology, Vol. 67, No. 1, issue of March 1954, p. 26-38.

6 Champion, "The Acquisition and Extinction of the Fear Response", Op. Cit., p. 23.

stimulus, in close contiguity. After several trials, presentation of the CS alone is able to produce the fear response (CR), normally produced by the UCS. In this study the fear response (CR) is operationally defined as the subject's response to a tone previously paired with shock for several trials. The latency of the fear response is defined as the time between the onset of the tone and the effect of the fear response on a reaction time task.

It has been demonstrated by several investigators, viz., Kalish,[7] Brown and Jacobs,[8] that fear has the ability to motivate the subject in subsequent behaviour. Therefore fear is considered a secondary or acquired drive, the reduction of which is considered reinforcement for the acquisition of new responses. Because fear is a learned response, factors such as contiguity and reinforcement are considered to affect its acquisition. A method that has often been used to investigate the effect of these variables is the probe stimulus technique.

Brown, Kalish and Farber[9] developed the probe stimulus technique, because they objected to the lack of precision

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7 Kalish, Op. Cit., p. 1-9.

8 Brown and Jacobs, Op. Cit., p. 747-759.

9 Judson S. Brown, Harry I. Kalish, and I.E. Farber, "Conditioned Fear as Revealed by Magnitude of Startle Response to an Auditory Stimulus", Journal of Experimental Psychology, Vol. 41, No. 5, issue of May 1951, p. 317-328.

associated with the fear reduction method. A major problem with this method was that it did not allow the investigator to follow the development of the fear response in relation to training trials. Assuming that fear has drive properties as well as reinforcement properties they reasoned that fear would affect the amplitude and latency of a response made to any stimulus (the probe stimulus) which was presented in conjunction with the CS. In their study on fear conditioning with rats, they employed as the probe stimulus a loud auditory stimulus whose response was the startle response. By comparing changes in the latency and amplitude of the startle response relative to various periods preceding, and during acquisition and extinction of the fear response, they were able to investigate the development and deterioration of the response.

Spence and Runquist[10] applied the same technique to the study of conditioned fear in humans; they used as their probe stimulus response the eyelid reflex. Their major interest was the effect of varying degrees of reinforcement on the development of the fear response. Incidental to results concerning this phenomenon, they found evidence to suggest that the latency of the conditioned fear response is more than 0.5 seconds and

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10 K.W. Spence and W.N. Runquist, "Temporal Effects of Conditioned Fear on the Eyelid Reflex", Journal of Experimental Psychology, Vol. 55, No. 6, issue of June 1958, p. 613-616.

that it is likely about 4.5 seconds. Ross[11] carried out a similar experiment, in which he manipulated the CS-UCS interval in fear conditioning. He measured the effects of this variable by means of the eyelid reflex, which acted as his probe stimulus response. He also found evidence to suggest that the latency of the fear response was greater than either 0.5 or 2 seconds.

The indications of these studies provoked Champion[12] to investigate the latency of the conditioned fear response as the major variable. Instead of the eyelid reflex he used as his probe stimulus response key pressing in response to a light flash. In his study, forty-four subjects were subjected to fear conditioning by means of a tone as the CS and shock as the UCS. As has been reported above he obtained a dichotomy of probe stimulus response latencies among his subjects, which he suggested was the result of anxiety. Due to past misunderstanding concerning anxiety as it is used in learning theory the concept of anxiety will be expanded more fully in the next section.

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11 Leonard E. Ross, "Conditioned Fear as a Function of CS-UCS and Probe Stimulus Intervals", Journal of Experimental Psychology, Vol. 61, No. 4, issue of April 1961, p. 265-273.

12 Champion, "The Latency of the Conditioned Fear Response", Op. Cit., p. 75-83.

3. Anxiety.

The other variable to be manipulated in this study will be level of anxiety. In comparison to fear, a response, anxiety is usually viewed as a persisting state of the organism. Champion[13] makes this distinction and suggests that while the conditioning of fear is dependent on environmental cues, anxiety is the result of successive noxious stimulation over a brief or an extended period of time. In agreement with this view, Sarnoff and Zimbardo[14] state that fear is aroused whenever the organism is confronted with a dangerous or potentially dangerous stimulus, while anxiety may be aroused by innocuous stimuli. In his article Champion[15] defines anxiety as emotionality, a state variable, which suggests he considers anxiety in the same terms as the Iowa group. Taylor[16] developed the Manifest Anxiety Scale (MAS) as a selection tool to obtain extreme groups exhibiting this variable. Although Champion does not suggest this as a measure of anxiety in his paper, it

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13 Ibid., p. 75.

14 Irving Sarnoff and Phillip G. Zimbardo, "Anxiety, Fear and Social Affiliation", Journal of Abnormal and Social Psychology, Vol. 62, No. 2, issue of March 1961, p. 356-363.

15 Champion, "The Latency of the Conditioned Fear Response", Op. Cit., p. 75.

16 Janet A. Taylor, "The Relationship of Anxiety to the Conditioned Eyelid Response", Journal of Experimental Psychology, Vol. 41, No. 2, issue of February 1951, p. 81-92.

is evident that this is the measure he is discussing. In order to clarify this point this author wrote to Champion and he replied that the MAS could be used as a measure to select high and low anxiety groups for the proposed study.[17]

The original MAS consisted of sixty-five items assumed to measure drive level as it is reflected by symptoms of manifest anxiety and 150 buffer items, which did not reflect anxiety. This form has been revised several times, such that the present test consists of fifty items and forty buffer items. Extensive normative data is available for this scale, viz., Taylor.[18] In this report she states that the test-retest coefficient with a sample of 113 subjects for a five month period was .82. Over a nine to seventeen month period with a sample of fifty it was .61.

Prior to discussing the validity of the MAS, the purpose for which this test was designed should be recalled. It was not designed to measure anxiety but rather to select subjects of varying drive level. Because of the confusion that has arisen, Taylor[19] feels it might have been given another title

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17 R.A. Champion, Professor of Psychology, University of Sydney, Personal Correspondence with the Author, letter dated December 7, 1965.

18 Janet A. Taylor, "A Personality Scale of Manifest Anxiety", The Journal of Abnormal and Social Psychology, Vol. 48, No. 2, issue of 1953, p. 285-290.

19 --------, "Drive Theory and Manifest Anxiety", Psychological Bulletin, Vol. 53, No. 4, issue of July 1956, p. 303-320.

such as a scale of emotionality. Any studies attempting to test its validity against either clinical or physiological measures of anxiety do not test its validity as a measure of general drive level (D), which is a hypothetical construct. Two other methods of testing its validity are possible, these are construct validity, or its validity in relation to other measures of D. Construct validity is demonstrated whenever a hypothesis, in which the MAS is used as a measure of D, is accepted. One attempt has been made to assess the validity of the MAS in relation to another measure of D. Kamin and Fedorchak[20] compared the effects of D as measured by the MAS and food deprivation. Their hypothesis could not be accepted, but it is felt this was due to their failure to obtain normative data concerning food deprivation in humans.

As was stated in the previous paragraph, the usual method of validating the MAS has been construct validity. In this method as hypotheses are accepted or rejected the definition of anxiety as measured by the MAS is modified in relation to the findings. In recent literature, Taylor,[21] Smock,[22]

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20 Leon J. Kamin, and Olga Fedorchak, "The Taylor Scale, Hunger, and Verbal Learning", Canadian Journal of Psychology, Vol. 11, No. 4, issue of December 1957, p. 212-218.

21 Taylor, Op. Cit., p. 303.

22 Charles D. Smock, "Perceptual Sensitization to Threat Objects as a Function of Manifest Anxiety", Child Development, Vol. 34, No. 1, issue of March 1963, p. 161-167.

Farber and Spence,[23] MAS scores are considered to measure a state of emotionality, emotional responsiveness, or reactivity and excitability respectively, which in turn reflects level of D. Further Malmo[24] considers that there is no distinction between emotionality as measured by the MAS, and activation. Conclusions drawn from this discussion leave little doubt that the MAS measures the variable, which Champion[25] suggests should be manipulated. For the purpose of this study anxiety will be operationally defined as that which is measured by the MAS.

4. The Effect of Anxiety.

Although, the motivation for using a simple reaction time task as the probe stimulus technique was based on Champion's[26] use of such a task, further support for its use has emerged from the literature. To date most studies on anxiety and simple reaction time have shown that this phenomenon is not affected by level of anxiety, viz., Farber and Spence,[27]

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23 I.E. Farber and Kenneth W. Spence, "Complex Learning and Conditioning as a Function of Anxiety", Journal of Experimental Psychology, Vol. 45, No. 2, issue of February 1953, p. 120-125.

24 Robert B. Malmo, "Activation", in Arthur J. Bachrach (ed.), Experimental Foundations of Clinical Psychology, New York, Basic Books, 1962, 386 p.

25 Champion, "The Latency of the Conditioned Fear Response", Op. Cit., p. 75-83.

26 Ibid.

27 I.E. Farber and Kenneth W. Spence, "Effects of Anxiety, Stress and Task Variables on Reaction Time", Journal of Personality, Vol. 25, No. 1, issue of September 1956, p. 1-18.

Desiderato,[28] and Castenada.[29] It is expected then that the high and low anxiety groups would not differ in their reaction times at the various CS-PS intervals.

However, it is expected on the basis of earlier work that level of anxiety will affect the acquisition of the fear response, viz., Tayler,[30] Spence and Spence.[31] These studies suggest that the high anxiety group will attain a higher level of fear conditioning than the low anxiety group. The effect of fear on the probe stimulus task is, therefore, expected to produce a decrease in reaction time following fear conditioning.

Therefore, in this study the expectation is that the high anxiety group will show a greater decrease in reaction time to the probe stimulus than the low anxiety group at the CS-PS interval, at which fear is strongest. On the basis of Champion's study the CS-PS interval at which the fear response is expected to be maximum is 3.5 seconds.

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28 Otello Desiderato, "Effect of Anxiety and Stress on Reaction Time and Temporal Generalization", Psychological Reports, Vol. 14, No. 1, issue of February 1964, p. 51-58.

29 Alfred Castenada, "Reaction Time and Response Amplitude as a Function of Anxiety and Stimulus Intensity", Journal of Abnormal and Social Psychology, Vol. 53, No. 2, issue of September 1956, p. 225-228.

30 Taylor, "The Relationship of Anxiety to the Conditioned Eyelid Response", Op. Cit., p. 81-92.

31 Kenneth W. Spence and Janet Taylor Spence, "Relation of Eyelid Conditioning to Manifest Anxiety, Extraversion, and Rigidity", Journal of Abnormal and Social Psychology, Vol. 68, No. 2, issue of 1964, p. 144-149.

This study will examine two hypotheses, a) that anxiety will affect the latency of the probe stimulus response, and b) that a difference in difference scores in response latency following conditioning will occur at the CS-PS interval of 3.5 seconds for the two groups.

To summarize, the review of an article by Champion[32] suggested that a dichotomy, among his subjects, in latency of their response to conditioned fear may be the result of differences in level of anxiety. Fear is defined as a conditioned response, which results from the presentation of a neutral and a noxious stimulus in close contiguity for several trials. The probe stimulus technique was considered as a means of measuring the latency of the conditioned fear response, and the Manifest Anxiety Scale was chosen to distinguish high and low anxiety groups. Studies concerning the effect of anxiety on the probe stimulus response and conditioned fear were examined, and from these studies it was hypothesized that a) anxiety would affect the latency of the probe stimulus response, and b) that a group of high anxiety and low anxiety subjects would change most in their probe stimulus response latencies at the 3.5 second CS-PS interval. In the following chapter the method used to test these hypotheses will be discussed.

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32 Champion, "The Latency of the Conditioned Fear Response", Op. Cit., p. 75-83.

CHAPTER II

EXPERIMENTAL DESIGN

The following design was developed to test the hypothesis that level of anxiety would affect measurement of the latency of the conditioned fear response. On the basis of their scores on the MAS, two groups of subjects were selected to participate in the experiment. The fear response was conditioned by presenting a tone and shock in close contiguity. Before fear conditioning each subject was presented with the probe stimulus pre-test. During the last nine trials of fear conditioning the probe stimulus post-test was administered. More extensive details of the method are outlined in the following sections.

1. Subjects.

Sixty-four subjects were selected to participate in the experiment. The MAS was administered to 208 students from Lakeshore Teachers College on two occasions separated by seven weeks. The MAS consisted of the fifty revised items of the scale and forty buffer items. The test-retest reliability for the scores of the 208 subjects over the seven week period was

.86. The distributions on the two occasions were similar to those reported by Taylor.[1]

Thirty-two of the students who scored at or below the twentieth percentile on both occasions were assigned to the low anxiety group, while the thirty-two subjects who scored at or above the eightieth percentile on both occasions were assigned to the high anxiety group. These criteria were selected on the basis of their extensive use in other studies, viz., Wenar,[2] Desiderato.[3] As age and sex distributions were the same for both groups, these variables were not controlled for further. The median age for each group was found to be nineteen years. There were ten males and twenty-two females in each group. In the low anxiety group anxiety scores ranged between 3 and 10, and in the high anxiety group scores ranged between 25 and 44. These ranges are consistent with those found in other studies,

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1 Janet A. Taylor, "A Personality Scale of Manifest Anxiety", Journal of Abnormal and Social Psychology, Vol. 48, No. 2, issue of 1953, p. 285-290.

2 Charles Wenar, "Reaction Time as a Function of Manifest Anxiety and Stimulus Intensity", Journal of Abnormal and Social Psychology, Vol. 49, No. 3, issue of July 1954, p. 335-340.

3 Otello Desiderato, "Effect of Anxiety and Stress on Reaction Time and Temporal Generalization", Psychological Reports, Vol. 14, No. 1, issue of February 1964, p. 51-58.

viz., Bindra et al.,[4] Beck.[5] Of the sixty-four subjects selected, five of the high anxiety group and two of the low anxiety group failed to keep their appointment. As a result the final high anxiety group consisted of twenty-seven subjects and the low anxiety group consisted of thirty subjects. These subjects appeared for the experiment in a prearranged random order.

2. Apparatus.

A tone was used as the CS and electric shock acted as the UCS in fear conditioning. The 2,000 cycle per second tone was produced by a standard tone generator and amplified by the amplifier of an Ampex tape recorder. The tone was presented through earphones at a level of 60 decibels. The shock was at a current of 0.5 milliamps, and was at the voltage level which the subject reported to be painful. The shock was produced by a standard Hunter shock stimulator, and was presented to the subject through finger electrodes attached to the ring and index fingers of the subject's right hand.

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4 Dalbir Bindra, Alan L. Paterson, and Joanna Strzelecki, "On the Relation between Anxiety and Conditioning", Canadian Journal of Psychology, Vol. 9, No. 1, issue of March 1955, p. 1-6.

5 Sally Bell Beck, "Eyelid Conditioning as a Function of CS Intensity, UCS Intensity, and Manifest Anxiety Scale Score", Journal of Experimental Psychology, Vol. 66, No. 5, issue of November 1963, p. 429-436.

The Probe Stimulus (PS) was a 0.5 second flash of a six volt D.C. lamp, placed near the subject's right hand. A telegraph key was provided for the subject to respond to the PS. Above the key was a 2" by 4" platform, which acted as a handrest for the subject's right hand. The interval between the PS and its response was measured by means of an electric clock, accurate to the nearest one onehundredth of a second.

A three-channel, 35 mm, film programmer was used to control the sequence and duration of the stimuli. The one channel initiated the CS and terminated it after 8 seconds. Another initiated the UCS 0.5 seconds following the termination of the CS, and terminated it after 0.5 seconds. The third channel was used to trigger a Hunter timer, which initiated the PS at the desired interval following the onset of the CS on the CS-PS trials.

3. Procedure.

The experiment was carried out in a two-room laboratory consisting of a subject room, and an apparatus room, between which was a one-way mirror and an intercom. In the subject room was a table and a chair, and the apparatus which the subject would use. The lamp and the telegraph key were on the table close to the subject's right hand. In the apparatus room was the remainder of the apparatus outlined above.

Before volunteering for the experiment subjects were informed that they would receive shock, and they were asked to sign a consent form. Each subject was placed in the subject room, the shock electrodes were attached to his right hand, and the earphones were adjusted over his head. He was instructed to place his right hand on the platform over the telegraph key. The experimenter then retired to the apparatus room and communication was through the intercom from then on.

The subject was told that it was necessary to obtain the highest level of shock that he could stand. Shock was then gradually introduced until the subject asked that it be terminated. This level was used during the fear conditioning trials. To acquaint the subject with the PS and its response, the PS was presented alone for five trials and the subject was asked to respond to it by depressing the key as quickly as possible following the onset of the light.

The PS pre-test was then administered to the subject. This consisted of six trials in which the PS followed the onset of the CS by each of the following intervals: 0.5, 1.5, 2.5, 3.5, 4.5, or 5.5. The sequence of these intervals was at random for each subject. The reaction time to each of the PS intervals was recorded.

Each subject was then presented nine conditioning trials. The eight second CS was followed after 0.5 seconds by the UCS for 0.5 seconds. In order that the subject was not startled by

by later CS-PS trials, two such trials were introduced after the second and fifth conditioning trials. The CS-PS intervals in these trials were chosen at random for each subject, and the reaction times were not recorded.

The final stage of the experiment involved the PS post-test. Ten further CS-PS trials were presented, and a CS-PS trial was inserted after the ninth conditioning trial and after conditioning trials 10 or 11, 12 or 13, 14 or 15, 16 or 17. The order of the CS-PS intervals was again varied randomly for each subject, with the provision that no subject had the same order as in the pre-test. The position of each CS-PS trial was also varied randomly for each subject among the final ten conditioning trials.

In summary then, each subject received thirty-nine trials in all, UCS alone, five trials of the PS alone, six PS pre-test trials, nineteen conditioning trials, two CS-PS trials not scored, and the six PS post-test trials. Each of these trials was separated by 45, 50, or 55 seconds according to a prearranged random order. No ready signal was given on conditioning trials, but on the CS-PS trials the subject was given a verbal ready signal four seconds before the onset of the CS. The null hypotheses and the results will be presented in the following chapter.

CHAPTER III

PRESENTATION OF RESULTS

As was stated in Chapter I, two research hypotheses will be examined. The first is that there is a difference in reaction time for the two groups at each of the six CS-PS intervals. This will necessitate testing the following six null hypotheses:

1. There is no difference between reaction times to the probe stimulus at the 0.5 second CS-PS interval for the high anxiety and the low anxiety groups.

2. There is no difference between reaction times to the probe stimulus at the 1.5 second CS-PS interval for the high anxiety and low anxiety groups.

3. There is no difference between reaction times to the probe stimulus at the 2.5 second CS-PS interval for the high anxiety and low anxiety groups.

4. There is no difference between reaction times to the probe stimulus at the 3.5 second CS-PS interval for the high anxiety and low anxiety groups.

5. There is no difference between reaction times to the probe stimulus at the 4.5 second CS-PS interval for the high anxiety and low anxiety groups.

6. There is no difference between reaction times to the probe stimulus at the 5.5 second CS-PS interval for the high anxiety and low anxiety groups.

It is not expected that these null hypotheses will be rejected, in which case it must be assumed that anxiety does not affect reaction time to the probe stimulus at any of the CS-PS intervals.

The second hypothesis is that there is a maximum difference in difference scores of reaction times to the PS of the high and low anxiety groups at the 3.5 second CS-PS interval. The following null hypotheses concerning the six CS-PS intervals must be examined in conjunction with this hypothesis:

1. There is no difference in differences between pre and post conditioning reaction times to the PS at the 0.5 second CS-PS interval for the high and low anxiety groups.

2. There is no difference in differences between pre and post conditioning reaction times to the PS at the 1.5 second CS-PS interval for the high and low anxiety groups.

3. There is no difference in differences between pre and post conditioning reaction times to the PS at the 2.5 second CS-PS interval for the high and low anxiety groups.

4. There is no difference in differences between pre and post conditioning reaction times to the PS at the 3.5 second CS-PS interval for the high and low anxiety groups.

5. There is no difference in differences between pre and post conditioning reaction times to the PS at the 4.5 second CS-PS interval for the high and low anxiety groups.

6. There is no difference in differences between pre and post conditioning reaction times to the PS at the 5.5 second CS-PS interval for the high and low anxiety groups.

The expectancy is that the null hypothesis concerning the 3.5 second CS-PS interval will be rejected, while those concerning the five other CS-PS intervals will not be.

The design of this experiment is such that each subject has a pre and post measure at each of the six CS-PS intervals. In testing the first set of null hypotheses the pre measures for each group at each of the six CS-PS intervals will be compared. To test the second set of null hypotheses the differences for each group at each of the intervals will be compared. The difference score is the pre-test reaction time subtracted from the post-test reaction time to the PS. Following these comparisons the null hypotheses will be tested.

In a reaction time study a normal frequency distribution is not obtained because it is easier to obtain a long reaction time than it is to obtain a short reaction time. This observation applies equally well to change in reaction time, in which case it is more difficult to reduce a short time than a long time. Due to these floor effects a skewed distribution results, and comparison of such distributions cannot be achieved by parametric statistics. For this reason the Mann-Whitney U test,

as described by Siegel,[1] was used to analyze the results of this experiment.

The results of this experiment will be discussed under the following headings:

1. Analysis of the pre-test distributions.
2. Analysis of pre-post test difference distributions.
3. Testing the null hypotheses.

1. Analysis of the Pre-Test Distributions.

The probe stimulus pre-test reaction times for the high and low anxiety groups were compared by means of the Mann-Whitney U test. The results of these analyses are shown in Table I.

2. Analysis of Pre-Post Test Difference Distributions.

In order to show the change in reaction time to the probe stimulus between the PS pre-test and the PS post-test, the pre-test reaction time for each subject at each interval was subtracted from the equivalent post-test reaction time. This procedure yielded a difference score for each subject at each CS-PS interval. The distributions of difference scores for each of the two groups were compared at each of the six CS-PS

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1 Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences, New York, McGraw-Hill, 1956, p. 116-127.

Table I.-

Results of Statistical Analyses between Distributions of Pre Conditioning Probe Stimulus Response Latencies for the High and Low Anxiety Groups at each of the CS-PS Intervals.

CS-PS Interval	U	z	Probability[a]	Significance[b]
0.5	432	.43	p=.6672	Not significant
1.5	369.5	.57	p=.5686	Not significant
2.5	370.5	.55	p=.5824	Not significant
3.5	334.5	1.13	p=.2564	Not significant
4.5	446	.66	p=.5092	Not significant
5.5	365.5	.63	p=.5286	Not significant

a Two-tailed probability under Ho of z.

b The 5% level or better is considered significant.

intervals by application of the Mann-Whitney U test. The results of these analyses are given in Table II.

3. Testing the Null Hypotheses.

The five per cent level of significance is taken as the rejection level at which a null hypothesis will be rejected. None of the six null hypotheses concerning the comparison of high and low anxiety groups on reaction time to the probe stimulus prior to fear conditioning at each of the CS-PS intervals could be rejected. Therefore it is assumed that level of anxiety does not affect reaction time to the probe stimulus at any of the six CS-PS intervals.

Of the second group of null hypotheses tested concerning the comparison of difference scores between the two groups at each of the six intervals, only those concerning the 0.5 and 3.5 CS-PS intervals could be rejected. The direction of both distributions suggests that the high anxiety group achieved a greater decrease in reaction times following fear conditioning than did the low anxiety group. At the 1.5, 2.5, 4.5 and 5.5 second CS-PS intervals it must be assumed that there were no differences between the two groups.

The interpretation and implications of these results will be discussed in terms of the theory outlined in Chapter I in the following chapter.

Table II.-

Results of Statistical Analyses of the Differences between Distributions of Difference Scores for the High and Low Anxiety Groups at each of the Six CS-PS Intervals.

CS-PS Interval	U	z	Probability[a]	Significance[b]
0.5	557	2.43	p=.0150	Significant
1.5	370	.36	p=.3754	Not Significant
2.5	360.5	.71	p=.4770	Not Significant
3.5	539	2.14	p=.0324	Significant
4.5	394	.90	p=.3682	Not significant
5.5	487	1.31	p=.1902	Not Significant

a Two-tailed probability under Ho of z.

b The 5% level or better is considered significant.

CHAPTER IV

DISCUSSION OF RESULTS

The discussion of the results will be made under the following headings:

1. Anxiety and the probe stimulus response.

2. Anxiety and fear conditioning.

3. Implications of the results.

At the end of this chapter a summary of the research and the conclusions will be given.

1. Anxiety and the Probe Stimulus Response.

It was found that anxiety did not affect the latency of the probe stimulus response, since none of the null hypotheses concerning this relationship could be rejected. This assumption is in accord with the findings of Farber and Spence,[1] Desiderato,[2] and Castenda.[3] Therefore, any changes between

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1 I.E. Farber and Kenneth W. Spence, "Effects of Anxiety, Stress and Task Variables on Reaction Time", Journal of Personality, Vol. 25, No. 1, issue of September 1956, p. 1-18.

2 Otello Desiderato, "Effect of Anxiety and Stress on Reaction Time and Temporal Generalization", Psychological Reports, Vol. 14, No. 1, issue of February 1964, p. 51-58.

3 Alfred Castenada, "Reaction Time and Response Amplitude as a Function of Anxiety and Stimulus Intensity", Journal of Abnormal and Social Psychology, Vol. 53, No. 2, issue of September 1956, p. 225-228.

the latency of the probe stimulus pre-test and the probe stimulus post-test must be attributed to the effects of anxiety upon fear conditioning in each group.

2. Anxiety and Fear Conditioning.

The hypotheses that the high anxiety group show greater decrement of latency to the probe stimulus after conditioning at the 0.5 and 3.5 second CS-PS intervals is in agreement with Champion's[4] findings. He considered the difference at the 0.5 second interval an artifact, which was the result of testing each subject at each interval, rather than the result of conditioned fear. In this and Champion's study it is felt that the difference at the 0.5 second interval may be due to the close temporal proximity of the onset of the tone and the onset of the probe stimulus. Perhaps the onset of the tone 0.5 seconds before the onset of the light may have produced a differential level of distraction among subjects, which may have produced the difference between groups. It is not likely that this is the result of conditioned fear, on the basis of

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4 R.A. Champion, "The Latency of the Conditioned Fear Response", American Journal of Psychology, Vol. 77, No. 1, issue of March 1964, p. 75-83.

the findings of Ross,[5] and Spence and Runquist[6] that the latency of the conditioned fear response is greater than 0.5 seconds.

The difference at the 3.5 second CS-PS interval must be attributed to the differential strength of the conditioned fear response between groups. The fact that this difference occurred at 3.5 seconds following the onset of the CS is in support of Champion's finding that the latency of the conditioned fear response is of the order of 3.5 seconds.

3. Implications of the Results.

In agreement with several previous authors, viz., Castenada,[7] Desiderato,[8] and Farber and Spence,[9] the results of of this experiment suggest that it should be assumed that anxiety does not affect simple reaction time. This finding can be considered support for one of the two current hypotheses

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5 Leonard E. Ross, "Conditioned Fear as a Function of CS-UCS and Probe Stimulus Intervals", Journal of Experimental Psychology, Vol. 61, No. 4, issue of April 1961, p. 265-273.

6 K.W. Spence and W.N. Runquist, "Temporal Effects of Conditioned Fear on the Eyelid Reflex", Journal of Experimental Psychology, Vol. 55, No. 6, issue of June 1958, p. 613-616.

7 Castenada, Op. Cit., p. 225-228.

8 Desiderato, Op. Cit., p. 51-58.

9 Farber and Spence, Op. Cit., p. 1-18.

proposed by Spence,[10] and others concerning the relationship of level of anxiety to performance. The hypotheses are a) the 'chronic hypothesis', that high anxiety subjects react emotionally in a chronic manner to all situations, whether stressful or not, and b) the 'reactive hypothesis' that high anxiety subjects have a lower threshold of emotional responsiveness and react with a stronger emotional response than low anxiety subjects to situations involving some degree of stress. Since the two groups of subjects conditioned differentially to fear and yet did not vary in initial reaction times it is considered support is given to the reactive hypothesis.

Champion's[11] hypothesis that level of anxiety or arousal were responsible for the irregularity found in his results, which made it impossible for him to accept his main hypothesis that the latency of the conditioned fear response is 3.5 seconds, was also supported by the results of this experiment, as is his main hypothesis. This supports the contention of Champion[12] that the latency of the conditioned fear response is longer than had been assumed. This suggests

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10 Kenneth W. Spence, "A Theory of Emotionally Based Drive (D) and its Relation to Performance in Simple Learning Situations", American Psychologist, Vol. 13, issue of 1958, p. 131-141.

11 --------, "The Latency of the Conditioned Fear Response", Op. Cit., p. 75-83.

12 --------, "The Acquisition and Extinction of the Fear Response", Australian Journal of Psychology, Vol. 13, No. 1, issue of 1961, p. 23-28.

that responses considered the result of conditioned fear be reexamined in the light of these results along the lines suggested by Champion.[13]

As predicted by Spence[14] and his colleagues level of anxiety acted to produce different levels of fear conditioning among the two groups. This result may be taken as further support for the construct validity of the Manifest Anxiety Scale.

In summary then, support was found for the reactive hypothesis relating Manifest Anxiety Scale scores to performance, and for the construct validity of the MAS. Finally, the hypothesis that conditioned fear has a latency of 3.5 seconds was supported.

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13 Ibid., p. 23-38.

14 Spence, Op. Cit., p. 131-141.

SUMMARY AND CONCLUSIONS

In order to examine two research hypotheses, a) that there is a difference in response latency to a probe stimulus at each of six CS-PS intervals for a high and low anxiety group, and b) that the high anxiety group would show a significant decrease in response latency to the probe stimulus over the low anxiety group at the CS-PS interval of 3.5 seconds, two groups totalling fifty-seven subjects were selected on the basis of the Manifest Anxiety Scale. Twenty-seven high anxiety and thirty low anxiety subjects were given a probe stimulus pre-test consisting of six CS-PS intervals. All subjects were then conditioned to give a fear response to a tone for nineteen trials; during the final ten conditioning trials the six trials of the probe stimulus post-test were inserted at random.

The measures resulting from this procedure were analyzed. The first hypothesis could not be accepted and it must be assumed that level of anxiety does not affect simple reaction time. This finding is in agreement with several earlier studies.

Two hypotheses concerning decrease in latency of the probe stimulus response following conditioning were accepted, those being the 0.5 and the 3.5 second CS-PS intervals. The hypotheses concerning the 0.5 second interval was discussed in the light of earlier findings to this effect and in terms

of the present experiment. It was concluded that level of anxiety did affect the level of fear conditioning, which in turn produced differences in response latency at the 3.5 second interval indicates three conclusions.

It can be concluded that level of anxiety does affect level of fear conditioning. Secondly, because a significant difference between this effect occurred at the 3.5 second CS-PS interval the latency of the conditioned fear response is 3.5 seconds. Thirdly, the construct validity of the MAS is further expanded in that the predicted result was obtained, and support for the "reactive hypothesis" was found.

BIBLIOGRAPHY

Brown, Judson S., Harry I. Kalish and I.E. Farber, "Conditioned Fear as Revealed by Magnitude of Startle Response to an Auditory Stimulus", Journal of Experimental Psychology, Vol. 41, No. 5, issue of May 1951, p. 317-328.

This is the original paper discussing the rationale and use of the probe stimulus technique in the assessment of conditioned fear. This paper was of use in the discussion of the probe stimulus technique in relation to conditioned fear.

Champion, R.A., "The Acquisition and Extinction of the Fear Response", Australian Journal of Psychology, Vol. 13, No. 1, issue of 1961, p. 23-38.

This is an excellent review of the present theory concerning the conditioned fear response. It was essential as a frame of reference for the problem at hand.

--------, "The Latency of the Conditioned Fear Response". American Journal of Psychology, Vol. 77, No. 1, issue of March 1964, p. 75-83.

This is the earlier study out of which the present study stemmed. As such it was essential to all phases of the present study.

Ross, Leonard E., "Conditioned Fear as a Function of CS-UCS and Probe Stimulus Intervals", Journal of Experimental Psychology, Vol. 61, No. 4, issue of April 1961, p. 265-273.

One of the few studies employing the probe stimulus as a measure of the effect of various variables on the acquisition of the fear response. As such it was of support to the theory of this study.

Spence, Kenneth W., "A Theory of Emotionally Based Drive (D) and its Relation to Performance in Simple Learning Situations", American Psychologist, Vol. 13, issue of 1958, p. 131-141.

A recent work on the current status of the MAS as a measure of emotionality. This paper was of importance in the selection of the MAS as a selection device.

-------- "Anxiety (Drive) Level and Performance in Eyelid Conditioning", Psychological Bulletin, Vol. 61, No. 2, issue of February 1964, p. 129-139.

This paper is an excellent review of the present status of drive theory and conditioning. It was of value in the discussion and prediction of results in this study.

Spence, K.W. and M.N. Runquist, "Temporal Effects of Conditioned Fear on the Eyelid Reflex", Journal of Experimental Psychology, Vol. 55, No. 6, issue of June 1958, p. 613-616.

This paper reports the use of the probe stimulus technique in assessing the acquisition of the fear response. Therefore formed support for the theory of this paper.

Taylor, Janet A., "The Relationship of Anxiety to the Conditioned Eyelid Response", Journal of Experimental Psychology, Vol. 41, No. 2, issue of February 1951, p. 81-92.

This is the report of Taylor's Ph.D thesis in which the MAS was first used as a selection device. It gives the rationale behind the use of the MAS for this purpose.

---------, "A Personality Scale of Manifest Anxiety", Journal of Abnormal and Social Psychology, Vol. 48, No. 2, issue of 1953, p. 285-290.

This paper reports refinements of the MAS and extensive normative data concerning it. The MAS items reported were the basis for the MAS employed in this study.

---------, "Drive Theory and Manifest Anxiety", Psychological Bulletin, Vol. 53, No. 4, issue of July 1956, p. 303-320.

This paper further expands the theory relating anxiety to performance. It was of use in the discussion of the use of the MAS in this study.

APPENDIX 1

RAW DATA FOR THE LOW ANXIETY GROUP

APPENDIX 1

Table III.-

Raw Data for the Low Anxiety Group on the Probe Stimulus Pre-Test.

Subject	CS-PS Interval					
	0.5	1.5	2.5	3.5	4.5	5.5
1	44[a]	59	46	42	33	36
2	42	40	33	34	57	26
3	35	39	31	33	30	30
4	35	28	30	31	32	33
5	29	41	30	35	39	30
6	32	50	29	29	26	41
7	45	41	28	32	32	30
8	37	33	29	31	25	41
9	32	31	30	32	35	35
10	56	67	55	56	54	44
11	46	28	27	27	28	28
12	47	36	46	37	42	37
13	44	29	47	37	25	34
14	46	36	40	33	40	32
15	32	34	25	33	38	40
16	53	31	38	34	38	38
17	28	38	32	30	34	30
18	41	45	63	33	57	41
19	49	53	41	43	41	48
20	33	34	37	47	43	32
21	48	47	50	41	40	34
22	40	40	34	26	36	30
23	39	41	48	32	32	34
24	42	28	29	32	43	29
25	56	38	38	44	36	40
26	54	28	41	44	28	45
27	53	41	44	45	43	45
28	32	31	44	29	32	30
29	27	38	31	28	38	35
30	51	35	38	35	41	40

a All measures are in 1/100ths of a second.

Table IV.-

Raw Data for the Low Anxiety Group on the Probe Stimulus Post-Test.

Subject	CS-PS Interval					
	0.5	1.5	2.5	3.5	4.5	5.5
1	36[a]	39	41	39	49	43
2	44	45	46	44	54	50
3	38	34	31	35	31	35
4	43	41	38	37	34	46
5	53	36	54	26	33	36
6	45	43	35	39	64	30
7	49	40	34	45	44	33
8	48	42	38	41	43	40
9	31	38	32	40	33	34
10	43	52	36	34	54	39
11	51	30	28	33	32	30
12	47	41	46	41	38	42
13	56	53	34	39	34	44
14	61	40	45	50	42	46
15	57	38	35	29	38	44
16	39	32	44	34	46	35
17	56	35	30	31	36	33
18	34	30	38	35	30	31
19	56	41	40	47	45	64
20	41	31	46	39	43	39
21	41	33	30	37	32	36
22	42	40	31	34	37	35
23	30	31	35	37	25	37
24	78	44	33	54	46	35
25	47	53	43	43	47	48
26	42	29	34	30	28	32
27	61	48	48	49	48	45
28	35	33	31	28	35	42
29	28	37	25	31	31	30
30	51	35	39	60	36	40

a All measures are in 1/100ths of a second.

APPENDIX 2

RAW DATA FOR THE HIGH ANXIETY GROUP

APPENDIX 2

Table V.-

Raw Data for the High Anxiety Group on the Probe Stimulus Pre-Test.

Subject	CS-PS Interval					
	0.5	1.5	2.5	3.5	4.5	5.5
1	45[a]	30	30	30	46	33
2	38	30	42	52	41	60
3	50	47	40	33	42	42
4	50	52	39	38	38	37
5	89	31	47	35	31	33
6	36	43	35	44	50	65
7	33	31	31	31	29	27
8	34	41	40	66	40	35
9	30	30	44	36	31	33
10	48	54	39	53	27	47
11	33	52	37	33	25	29
12	27	28	30	27	31	29
13	68	54	50	63	48	76
14	27	41	25	82	31	54
15	73	52	63	50	50	53
16	48	29	30	33	31	28
17	63	35	34	27	30	31
18	55	26	30	26	31	27
19	30	33	32	31	29	31
20	36	29	43	35	32	34
21	72	59	53	56	46	55
22	51	49	40	33	39	30
23	45	58	38	33	36	38
24	25	21	25	25	30	31
25	67	63	71	42	46	71
26	43	38	34	38	36	33
27	45	42	39	43	40	39

a All measures are in 1/100ths of a second.

Table VI.-

Raw Data for the High Anxiety Group on the Probe Stimulus Post-Test.

Subject	CS-PS Interval					
	0.5	1.5	2.5	3.5	4.5	5.5
1	38[a]	37	32	36	41	36
2	41	31	39	32	34	35
3	42	65	46	38	39	39
4	33	56	57	37	55	49
5	70	30	35	31	39	39
6	48	45	36	33	40	41
7	35	34	36	31	51	56
8	58	42	36	37	35	37
9	62	66	41	43	35	48
10	34	51	49	40	26	30
11	28	36	28	29	32	34
12	38	28	36	23	37	32
13	58	58	62	52	53	60
14	50	34	61	30	22	59
15	46	50	45	40	39	41
16	47	38	34	29	30	31
17	38	39	32	35	36	29
18	39	35	33	34	32	31
19	30	33	49	32	33	35
20	27	40	36	37	34	36
21	63	46	55	52	54	59
22	43	45	56	43	39	40
23	42	39	58	48	50	45
24	28	29	24	24	21	25
25	61	56	44	47	39	60
26	30	43	38	36	40	32
27	33	45	37	38	44	44

a All measures are in 1/100ths of a second.

APPENDIX 3

ABSTRACT OF

Anxiety and the Latency of the Conditioned Fear Response

APPENDIX 3

ABSTRACT OF

Anxiety and the Latency of the Conditioned Fear Response.[1]

The effect of anxiety on the conditioned fear response was investigated in terms of the latency of the conditioned fear response. High and low anxiety groups were selected on the basis of Manifest Anxiety Scale scores. The conditioned fear response was produced by exposing the subjects to a tone and electric shock in close contiguity for nineteen trials. The probe stimulus technique was used to measure the latency of the conditioned fear response.

The assumption that anxiety does not affect simple reaction time had to be made on the basis of the results. The effect of anxiety on fear conditioning at the 0.5 second CS-PS interval was argued against on the basis of earlier findings. It was found that anxiety affected the degree of fear conditioning, which in turn produced a differential response for the two groups at the 3.5 second CS-PS interval. On the basis of this finding it was concluded that the latency of the conditioned fear response is of the order of 3.5 seconds. Support for the 'reactive hypothesis' relating level of anxiety to performance

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1 David R. Evans, Master's thesis presented to the Faculty of Psychology and Education of the University of Ottawa, Ontario, March 1966, vii-40 p.

was found. Further supporting the construct validity of the Manifest Anxiety Scale.