The Relationship between Anxiety and GSR Conditioning

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THE RELATIONSHIP BETWEEN ANXIETY AND GSR CONDITIONING

by

Frank J. Macchitelli

A Dissertation Submitted to the Faculty of the Graduate School of Loyola University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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1964
LIFE

Frank James Macchitelli was born in Chicago, Illinois, August 20, 1937.

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In August, 1959, he was awarded a National Defense Education Act fellowship which provided for three years of graduate study, full-time, at Loyola University, Chicago, Illinois, for the purpose of acquiring a doctorate in experimental psychology. He began his graduate studies at Loyola University in September, 1959, and from that time until June, 1963, he was a research member of the Loyola University Behavior Laboratory.

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CHAPTER I

INTRODUCTION AND PURPOSE

Within the last ten years there has been a tremendous output of research on anxiety scales. This is due to the fact that the concept of anxiety occupies a central position both in learning theory and personality theory. Any attempt, therefore, to get an objective measure of the anxiety level of an individual possesses a great deal of stimulus value for psychologists. The personality theorist and the clinician would like to be able to measure an individual's anxiety level as objectively as the physician measures the body-temperature of his patients. The learning theorist is more interested in anxiety as a drive and as a source of reinforcement through its reduction. Indeed, most of the research on anxiety scales has been done by psychologists interested in learning, to test anxiety as a drive. The line of reasoning behind the studies being that anxiety, since it is an irrelevant drive, contributes to the total motivational level of the subject and increases the quantity obtained when habit strength and drive are multiplied.

In fact, it was to facilitate the study of drive factors in learning situations, primarily classical defense conditioning within the Hull-Spence theoretical framework, that prompted Janet A. Taylor to construct the first practical psychometric devise to "measure" an individual's anxiety level. Taylor devised the scale on the assumption that internal anxiety,
"emotionality," which is supposed to contribute to D, could be determined by a paper and pencil test of items describing what have been called overt symptoms of the state. The primary purpose behind the construction of the Taylor Manifest Anxiety Scale (MAS) was not to investigate anxiety per se, but to use the scale as a selective device in a program of research to test the assumption of a multiplicative relation between drive and habit strength.

The development of the Taylor MAS stimulated its use by many researchers, and also served as a model for the construction of other psychometric measures of anxiety (Bendig, 1956; Dixon, et al., 1957; Lykken, 1957; Mandler & Sarason, 1952; Sarason, 1958b; Welsh, 1952, 1956). As a result, today we have many indices of "general" anxiety as well as measures for specific kinds of anxiety—test, social, child. These indices may not be measuring the same thing and one of the important current problems involved in evaluating research using anxiety scales is a clarification of the similarities and differences of existing scales. Recent reviews (I. G. Sarason, 1960; Taylor, 1956) of work done with anxiety scales have pointed out many inconsistencies in studies employing the same dependent variables. Some of these inconsistencies may be due to the widespread use of "general" measures of anxiety, such as the MAS, as a basis for the operational definition of anxiety. Kimble (1961) has also pointed out that when the main research interest is in the intrinsic nature of anxiety, there is a definite need for a "purer" measure of anxiety than what we now have in existing scales. This problem may be clarified if more consideration were given to the construction of scales that would measure more specific types of anxiety.

There have been several factor analytic studies on the MAS (Bendig, 1960).
but they have produced little interest or research. One investigator, however (O'Brien, 1957) used factors obtained from one factorial analysis of the MAS (O'Connor, Lorr, and Stafford, 1956) to devise items to represent three of these factors, chronic anxiety, personal inadequacy, and motor tension. He succeeded in constructing scales for chronic anxiety and motor tension in his study, but he did not obtain his predicted curvilinear relationship between the two types of anxiety and problem solving ability.

Two psychologists from Loyola University (Chicago), R. C. Nicolay and R. E. Walker have taken a cue from O'Brien's work and, contributing innovations of their own, have developed the Nicolay-Walker Personal Reaction Schedule (PRS). The PRS has been devised to measure three basic sub-types of anxiety, motor tension, object and personal inadequacy. The scale has been constructed, primarily, as a research and a clinical instrument.

Several studies have attempted to relate anxiety level to galvanic skin response (GSR) conditioning. This work is similar to Taylor's study in which she found a significant relationship between the amount of conditioning of the eyelid response and level of anxiety as measured by the MAS (Taylor, 1951). It is interesting to note that when clinical judgements have been used to categorize subjects into various anxiety levels, a significant relationship has been found between anxiety level and rate of GSR conditioning. However, when anxiety scale scores are used for the same purpose, they fail to relate to GSR conditioning scores. Perhaps the inconsistency here is due partly to the fact that general indices of anxiety level have been used. With these scales it is impossible to determine how an individual relates to the various kinds of anxiety that are being measured by the scale. A high score on one
may be cancelled out by a low score on another when both are expressed as a single total score. Thus a possible relationship between one sub-type of anxiety and a dependent variable may not show up using these scales.

The purpose of this study will be to investigate the relationship between GSR conditioning and anxiety test scores using the Nicolay-Walker FRS. It is hypothesized that this scale will relate significantly better than general indices to a dependent variable, GSR conditioning, vulnerable to anxiety because it has been constructed to measure three relatively pure types of anxiety.
CHAPTER II

REVIEW OF THE LITERATURE

Studies relating anxiety level to simple conditioning measures have generally employed the GSR and the eyelid response as the conditioned reflexes. The majority of these studies can be grouped into three general categories: 1) those using contrasted groups (psychiatric patients and normals), 2) those using extreme groups (high and low scoring individuals in a distribution of anxiety scale scores), and 3) those using homogeneous samples (the total range of scores in a distribution of anxiety scale scores).

An experiment by Welch and Kubis (1947) was one of the earliest studies to demonstrate differences in rate of GSR conditioning between contrasted samples grouped on the basis of differences in anxiety level. Their work grew out of interest in earlier experiments (Kantorovich and Lukina, 1926; Rabinowich, 1932; Mays, 1934; Shipley, 1934; Tatarenko, 1935; Pfaffman and Schlosberg, 1936) which attempted to show the effects of various mental disorders on the conditioning of reflexes. Because of the many inconsistencies in the findings of these studies, it was difficult to arrive at a general summary of the results (Hilgard and Marquis, 1940). Welsh and Kubis felt that they could avoid many of the criticisms that were leveled at these studies if they considered only one clinical symptom—anxiety. Since anxiety may be present in any psychological disorder, they felt that, if they obtained positive results, they would not be discovering the reactions of one clinical
type differing radically from those of another. Welch and Kubis also hoped that, if they found a high correlation between the rate of conditioning and the intensity of anxiety, they might be able to substitute the subjective measure of anxiety based on a clinician's observations of a patient with a more objective measure expressed in terms of a conditioning score. A patient's anxiety level could then be expressed in units comparable between patients and understandable to all clinicians.

Welch and Kubis used both normals (college students) and psychiatric patients as subjects. The hospitalized group was categorized into different anxiety levels (intense, moderate, low) by experienced clinicians familiar with the patients. It was found that the speed with which a subject reached the criterion for conditioning was related to anxiety level; the more anxious an individual was, the faster he conditioned. The majority of the normals took 14 or more buzzers (the UCS) to reach the criterion; whereas, the majority of the patients took fewer trials. If the conditioning score of 14 is taken as a critical differentiating value, the conditioning scores agreed with the clinical diagnosis 96% of the time. Also, if a score of 3-6 is designated as representing great anxiety, 7-10 as moderate anxiety, and 11-14 as mild anxiety, the scores on the conditioning test are in agreement with the clinical diagnosis of anxiety level 59% of the time. If a two point scale made up of two categories, mild anxiety and intense and moderate anxiety combined, is used, the conditioning scores were found to be in agreement with the clinical diagnosis 91% of the time. Differences in age, general intelligence and sex did not appear to affect the rate of conditioning.

Schiff, Dougan and Welch (1949) replicated the above study but used
children instead of adults as subjects. The normals were selected from a local elementary school, and the hospitalized children came from a psychiatric ward of Bellevue Hospital. The investigators found that the hospitalized children required a mean of 18 busser to reach conditioning compared to a mean of 35 for the group of normal children of similar age. The correlation (Contingency) between GSR conditioning scores and the clinical diagnosis of anxiety level was significant (.01 level of confidence) at .52.

The differences obtained in the above studies cannot be attributed to greater general responsiveness among the anxious subjects because the criterion of conditioning in both studies was three successive conditioned GSR's that were higher than the responses to intervening noncritical syllables (in these studies a loud raucous buzzer served as the UCS and a nonsense syllable as the CS).

Pintal (1951) working with normals and psychotics recorded GSR amplitude to electric shock and to threat of shock in 450 normals and 450 psychotics. He found little difference between the groups in response to the shock, but there was a significantly smaller response in psychotics to the threat of shock.

In another comparison of contrasted groups, Spence and Taylor (1953) and Taylor and Spence (1954) found that neurotic subjects condition more readily in a threat situation, eyeblink conditioning, than do normals and that psychotics conditioned more readily than both neurotic and normal subjects. The differences obtained between the groups was attributed to an increase in motivation derived from anxiety. The differences in results obtained between these studies and Pintal's study (1951) may be attributed to the fact that
the latter studies employed conditioning as the dependent variable; whereas, the former study did not.

Working along similar lines, Herr and Kobler (1953) used the GSR to compare the responsiveness of normals and neurotics to emotionally toned words. They found that the individual words could not significantly distinguish between the two groups. But Herr and Kobler did find some groups of words to which the neurotics were, on the average, more responsive, and other groups of words to which the normals were, on the average, more-responsive. Therefore, by using a ratio score of the under-responsive words to the over-responsive words (the "Herr-Kobler" ratio), they were able to significantly distinguish between the two groups. The authors also reported their suspicion that a general anxiety factor seemed to run through the entire list of emotionally toned words.

Cabanski (1958) used Herr and Kobler's (1953) list of emotionally toned words, as well as the "Herr-Kobler" ratio, in a comparison of the GSR with the anxiety index originally developed and reported by Welsh (1952). He found no correlation which even approached significance between the GSR and the scores obtained on the Welsh Anxiety Index.

In a similar study, Williams (1961) recorded the GSR's of subjects who gave free-association type responses to the same list of emotionally-toned words standardized by Herr and Kobler (1953). Each subject had also completed the Taylor MAS and the Barratt Impulsiveness Scale (1959). He found no significant correlations of the GSR or "Herr-Kobler" ratio scores with either of these scales nor of these two scales with each other. The rank order of the magnitude of GSR responses to the emotionally-toned stimuli, reported by
Herr and Kobler (1953) and confirmed by Cabanski (1958) and others, was re-confirmed in this experiment.

Lykken (1957) found that primary psychopaths as compared with normals showed significantly less anxiety as measured by the Taylor MAS and the Welsh Anxiety Scale and also showed less of a GSR reaction to a CS associated with shock. The scores for both groups obtained from the two psychometric measures, however, did not show any significant relationship to the reactivity of the GSR to the CS with shock.

Howe (1958) conditioned the GSR in hospitalized anxiety states, normals, and hospitalized functional schizophrenics on the hypothesis that these three groups involved, respectively, a descending order of total drive strength (D) with respect to a noxious stimulus such as shock. Using the magnitude of response during experimental extinction as an indirect measure of conditioned strength, Howe found that the anxiety subjects showed significantly stronger GSR conditioning than both the normal and schizophrenic subjects. The schizophrenics showed the lowest magnitude of response, but this magnitude was not statistically less than for the normals. The differences between the groups was attributed to differences in motivation derived from anxiety.

One of the first studies to relate anxiety, as measured by an anxiety scale, to conditioning was Taylor's classical eyelid conditioning experiment (1951). Although not concerned with the measurement of anxiety per se, Taylor demonstrated that high and low anxious groups selected from a studied population on the basis of scores obtained from her Manifest Anxiety Scale differed significantly in the rate of conditioning. The findings were consistent with those of the above mentioned studies - the high anxious
conditioned more readily than the low anxious. It seemed, then, that a psychometric device, the Taylor MAS, could be used as an adequate measure of an individual's anxiety - doing away with both clinical ratings and conditioning scores as measures of individual anxiety level.

Spence and Farber (1953) replicated Taylor's experiment and found the same results - a significant relationship between eyelid conditioning and anxiety level.

Lacey and Smith (1955) investigated the generalization of a conditioned GSR. Normals were used as subjects; extreme groups, high and low anxious, were selected on the basis of scores obtained on the Heineman form of the MAS. Although generalization tended to vary directly with the anxiety scores, it was found that the groups were not significantly different. Rate of conditioning was not investigated in this study. Mednick (1957) replicated this study and found similar results.

In a replication of Taylor's experiment, but using a "homogeneous sample" instead of only the extremes in a distribution of MAS scores, Hilgard, Jones, and Kaplan (1951) failed to find a significant relationship between MAS scores and simple eyelid conditioning.

Bitterman and Holtzman (1952) felt that this failure to achieve a significant relationship between rate of conditioning and anxiety level using a homogeneous sample was a function of the insensitivity of the Taylor index. For this reason they designed an experiment to permit a comparison of simple GSR conditioning scores with the results of a more extensive clinical analysis of a homogeneous group of normal males. Experienced clinicians were used to rate the subjects in terms of anxiety level on the basis of test
results (MMPI and Rorschach) and an individual stress situation. They found that the GSR conditioned more readily and extinguished less readily in the high anxious group than in the low anxious group, confirming the hypothesis that anxiety is related to the rate of conditioning and extinction. However, when the subjects were divided into new groups on the basis of scores obtained from Taylor's MMPI index, the differences between the groups in conditioning rate was not significant. The new groups were not even significantly related to the clinical ratings. The experimenters concluded that the Taylor MAS was too insensitive to differentiate rates of conditioning in a homogeneous sample, but that GSR conditioning scores from a "normal" population may be sensitive enough to be of practical value in the psychiatric screening of specialized military personnel.

Beam (1950) designed an experiment to determine the effect of strong anxieties drawn from "real-life" situations, doctoral preliminary examinations, on performance and GSR conditioning. He used the real-life situations as a source of the anxiety because he felt that experiments in which anxiety had been assessed psychometrically had produced "somewhat equivocal results." He found that anxiety aroused in normals (college students) by real life situations hampered serial learning and facilitated GSR conditioning, and that the GSR reaction increased immediately before the anxiety arousing situations as compared to measures taken at other times. Beam also found that Taylor MAS scores were not related significantly to any of the performance measures, neutral or stress, nor to the Palmar-Sweat Index (PSI) (see Mowrer, 1950); whereas, the PSI was significantly related to the impairment of serial learning and the facilitation of GSR conditioning under stress (real-life)
conditions.

Franks (1957) found results similar to those of Hilgard, et al (1951) and Beam (1955). He used "unselected" (the total distribution of obtained scores, not merely the extremes) male and female college students as subjects. No significant relationship was found between level of eyeblink conditioning and scores obtained on the Neuroticism (N) scale of the Maudsley Personality Inventory. Since the N scale is highly correlated (approximately .90) with the Taylor MAS, Franks argued that his data gives support to the view that the MAS is too insensitive an index to differentiate between various anxiety levels in unselected normal samples.

Raphelson (1957) investigated relationships among three dispositional measures - need Achievement (McClelland et al, 1953), Mandler-Sarason Test Anxiety Questionnaire (Mandler and Sarason, 1952), and the Taylor MAS - and two physiological indices - skin conductance and respiratory volume - of anxiety in a competitive achievement situation. He found that Test Anxiety and n Achievement were specifically concerned with reactions in the competitive achievement situations and both were related to changes in skin conductance during the performance task. The relationships were clearest when the subjects were classified on both of these measures as anxious (high Test Anxiety and low n Achievement) or nonanxious (low Test Anxiety and high n Achievement). The more anxious group increased in conductance while the relatively nonanxious group decreased. The Taylor MAS did not relate to conductance change and no consistent relationships were found between respiratory activity and any of the other measures. Raphelson concluded that specific or "situational" measures have an advantage over general measures,
such as the Taylor Scale, in accounting for changes in skin conductance in particular anxiety provoking situations.

Realizing that results had been uniformly negative in terms of the relationship between anxiety and GSR conditioning when the Taylor MAS had been the sole measure of anxiety level, Berry and Martin (1957) selected subjects for a GSR conditioning experiment on the basis of scores obtained from the Sarason Test Anxiety Scale. Extreme ends of the distribution of scores were used, high anxious and low anxious. The investigators felt that the Test Anxiety Scale would be more predictive than the Taylor MAS because it measures a specific kind of anxiety. A factorial experimental design was used consisting of twelve treatment groups - male and female, three different kinds of instructions, and high and low anxious. It was expected that the differential instructions (apprehension arousing, neutral, and reassuring) given to the various groups would help to increase the probability of yielding a significant relationship between the anxiety scale scores and the GSR conditioning scores. However, no significant relationship was found between these two measures.

Rundquist and Ross (1959) measured pulse rate changes and GSR responses to a weak air-puff and formed two extreme groups as emotional and nonemotional on the basis of these two physiological measures. In comparing eyelid conditioning performances of these two groups, they found that the subjects who were highly responsive in physiological terms showed superior conditioning. A Pearson r was computed between each subject's Taylor MAS score and the larger of his two physiological measures. A low, but significant (.05 level of confidence) correlation of .22 was obtained between the two measures. The
authors interpreted the results as supporting a hypothesis which relates drive level (D) to emotional responsiveness.

Conditioning the GSR in a homogeneous group of normals, using shock as the UCS, Becker (1959) found evidence that the conditioning measures were reliable and reflected a conditioning process, but no relationships were found to questionnaire (Taylor MAS) measures of anxiety. In a later experiment, Becker and Matteson (1961) used the Cattell Anxiety (A) Scale instead of the Taylor MAS to gauge anxiety level. They selected four groups of 10 subjects scoring on the extremes of the A Scale and an extraversion measure, the Guilford R Scale. A significant positive relationship was found between A Scale scores and conditioning when response amplitude was used as a measure of conditioning but not when criterion conditioning scores were used. No relationship was found between extraversion and either of the conditioning measures.

In one of the most recent studies in this area of investigation, Gilberstadt and Davenport (1960) compared GSR conditioning scores with three different measures of anxiety. These measures were: 1) three clinical psychologists without knowledge of conditioning results independently categorized patients as high, medium or low anxiety types by inspection of psychology folders containing admission notes and routine admission tests, including the MMPI, 2) the Buss (1955) behavior rating scale was used by the psychiatrist in charge of the case who rated the patients on the basis of his brief admission interview, and 3) the patients were sorted into three approximately equal groups on the basis of the Taylor MAS items from the MMPI. After conditioning the GSR to shock, these investigators found that 1)
anxiety groups ranked on the basis of admission data by clinical psychologists were found to be significantly different in rate of conditioning and 2) anxiety groups ranked on the basis of the Taylor MAS MMPI index or brief psychiatric admission interviews were not significantly different in conditioning. The investigators concluded that their findings were consistent with those of Bitterman and Holtzman (1952), who used normals as subjects, in which judgements of anxiety by clinicians with several types of information available were significantly related to GSR conditioning, whereas, the Taylor MAS and brief psychiatric interviews were not.

Extreme groups, then, (high and low anxious) and contrasted groups (normals and psychiatric patients) have been differentiated in terms of simple conditioning measures, but the use of a homogeneous sample had produced no such differentiation when a general index of anxiety, such as the Taylor MAS, is used to measure individual anxiety level in the experimental sample.
CHAPTER III

PROCEDURE AND DESIGN

Apparatus

All of the experimental sessions were carried out in a semi-sound proof testing booth in the Loyola University perception laboratory (Lake Shore Campus). The booth was painted flat-gray and was without any distractive effects. A continuously operating exhaust fan provided ventilation as well as a constant masking noise to insure that the subject would not be disturbed by any distracting auditory stimuli. Two tables were placed in the room at corners opposite to each other. On one table was placed a Hull-type memory drum which was illuminated by a desk lamp containing a 60 watt bulb. In front of this table and facing the memory drum was placed a comfortable chair for the subject. On the other table were placed data sheets for recording the subject's responses and a B & W Lie Detector, Electronic Psychometer, (Model 8AC, B & W Associates, Michigan City, Indiana), a high gain resistance measuring device using a modified Wheatstone Bridge circuit especially designed for indicating GSR. The experimenter sat at this table facing the galvanometer. A foot-pedal switch was located under the table which enabled the experimenter to electrically control the presentation of stimuli in the memory drum.

The unconditioned stimulus (UCS) in this experiment consisted of a loud raucous electric door buzzer which was located on the wall at a distance of 2
feet from the subject's head. The conditioned stimulus (CS) was a certain three-letter nonsense-syllable (BAF) of low association value taken from Glaze's list (1928). The presentation and duration of the UCS with the CS was controlled through the use of electromagnetic relays and electric interval timers (Grayson Stadler, Elloch).

The measured reaction was the galvanic skin response. A visual reading of the response dial of the galvanometer was used to measure resistance changes as a result of stimulation. The deflections of response being quite accurately read to 1mm. of deflection. The galvanometer finger electrodes consisted of two highly polished chrome plates 1½ inches long and ½ inch wide. The electrodes were attached by means of split-ring fasteners to the palmar surface of the subject's second and fourth fingers of the dominant hand.

Because of the positioning of the chairs and equipment and the low illumination of the experimental chamber (the only light sources were from the response dial of the galvanometer and the desk lamp which faced the aperture of the memory-drum), the subject could not see the experimenter manipulating the galvanometer control dials and recording the responses. All of the electrical equipment was located in an adjacent experimental booth to prevent the subject from hearing the "clicking" of the relays involved in the instrumentation. (See Figure 1.).

Subjects and Procedure

Eighty male students (17-20 years old) of Loyola University were subjects in this experiment. All of the subjects were enrolled in freshman general psychology courses. The subjects volunteered for the experiment by writing
Fig. 1. A top-view sketch of apparatus arrangement used to condition the GSR.
their names on a sign-up sheet which was circulated in their psychology class. At Loyola University (Lake Shore Campus) all general psychology students are required to earn "credits" by serving as subjects in department-approved experiments carried out by upperdivision psychology students. The subjects were drawn from this pool. The sign-up sheets give no explanation of the nature of the experiment. The only information given is the name of the experiment, in this case it was "FLASH," the name of the experimenter, the location and the time required to run the experiment.

The Nicolay-Walker PRS was administered to all general psychology students on the first day of class before they had a chance to become "sophisticated" in psychology. The subjects did not know of the relationship between the earlier testing with the PRS and the experiment. Each subject was tested individually in one session.

The subject was seated in the chair placed directly in front of the memory drum. The subject was then given the following instructions:

This is a test measuring the effect of the startle response on the sweat activity of the hands. The startle response will be elicited periodically throughout the experiment by ringing this loud buzzer (demonstration given to S). It is necessary to test you in absolute rest. Hence to prevent you from thinking about anything that might upset you, we want you to read the meaningless syllables which will appear in this aperture (pointing to the memory drum). You must read the syllables aloud and as soon as they appear.

The subject was also told to remain as quiet and relaxed as much as possible and to refrain from moving around, sighing, taking deep breaths or talking other than what he was instructed to do in the experiment. It was
emphasized that violation of these instructions would only prolong the experimental session because all of the above reactions would result in a GSR and a consequent deflection of the galvanometer response needle. Time would then be required to recenter the galvanometer. Following this the subject was asked if he had any questions.

The experimenter next placed the finger electrodes on the subject. These electrodes connected the subject electrically to the bridge circuit of the galvanometer. In attaching the electrodes, care was taken to insure that they were not too tight to impede blood circulation in the fingers. Only sufficient pressure to keep the electrodes from falling off the fingers was used. The subject then was told to place his hands comfortably in his lap and to find a position that he could be relaxed in for the duration of the experiment.

After the subject settled down to his position, the experimenter centered the response meter needle of the galvanometer. By doing this, one balances out the unknown, the subject's resistance, in the Wheatstone Bridge circuit by adjusting a calibrated resistor. This was accomplished by using the Centering Control and Micro-Centering Control of the galvanometer. In the B & W Galvanometer the 15 unit mark on the response dial is the suggested centering point; although, any point on the dial can be used as long as the same point is used throughout the experimental session.

After centering the galvanometer, the experimenter set about determining the proper sensitivity setting for the subject. The B & W Sensitivity Control is the dial which reads from 0 to 100 that denotes the percentage of amplification of the GSR or meter needle deflection that the unit is set for.
If this amplification is set too low, little or no response will appear on the meter; if set too high, the response will appear in large quantities making it difficult for the experimenter to observe and record correct amounts of response because of excessive needle movement. When the proper sensitivity amplification is found, the setting provides the desired normal response of from 1 to 5 units. The majority of the subjects (64%) required a setting at 35 with the range going from 25 to 45. Sensitivity adjustments were made only at the beginning of the experiment, never during the experiment.

After this process of centering and setting the proper sensitivity level, which only took a few minutes, the subject was told that the experimenter was ready to begin the experimental session.

**TABLE I**

List of nonsense syllables of low-association value used in the experiment. The syllable in red denotes the nonsense syllable that served as the CS.

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<td>WIB</td>
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<td>MEP</td>
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<td>KEZ</td>
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Twelve nonsense syllables of low association value were then presented to the subject continuously and in a random order. They were typed in black letters on a continuous white tape. (See Table 1.). The syllables were exposed through a 2 3/4 x 3/8 inch aperture of the memory drum. One of the twelve syllables was the CS. The presentation of these stimuli was controlled.
electrically by the experimenter. A syllable was presented as soon as the GSR activity from the previous stimulus had subsided; the inter-stimulus interval, therefore, was not constant, but it averaged between 20-60 seconds in duration. If the meter needle did not return to the centering point after a full minute had elapsed, this meant that the subject's level of body resistance had changed to a lower level indicating added tension in the subject. On the other hand, there was a steady but gradual decline of the needle, this indicated that the subject's level of resistance was rising which meant that he was becoming more relaxed. Both conditions necessitated occasional recentering of the needle between responses.

When the CS appeared in the aperture of the memory drum, a micro-switch was activated by means of long wooden pegs placed on a rotary wheel attached to the axle of the memory drum motor. This switch, in turn, via an electromagnetic relay, activated the automatic electric interval timers which presented the UCS, the loud raucous buzzer, 1/3 second following the presentation of the CS and for a duration of 2 seconds. This pairing of the CS and UCS occurred only on alternate presentations of the CS. The 1/3 second interval between the onset of the conditioned stimulus (the syllable) and the unconditioned stimulus (the buzzer) was used because two experiments (White and Schlosberg, 1952; Moeller, 1954) have presented evidence that the probability of successful conditioning of the GSR is increased by using this interval. (See Figure 2.).

The criterion for conditioning consisted of three successive GSR reactions to the CS without its pairing with the UCS with the magnitude of each response greater than that of any response to the other nonsense
Fig. 2. Simplified schematic drawing of electrical circuit and apparatus used in conditioning the GSR.
syllables presented between the corresponding two buzzers (the two paired presentations of the CS-UCS). This criterion measure controlled to some extent the adaptation effects and the resistance level changes to the degree that these factors affected the conditioned response (CR) and the unconditioned response (UR) equally. It also seems logical that the criterion measure is appropriate in that conditioning is considered stronger the closer the CR approximates the UR.

An individual's conditioning score was computed by counting the number of times the buzzer was sounded before the record of the subject showed conditioning as determined by the criterion measure.

To get some idea of the subject's impression of the experimental situation, the following questions were asked at the end of the session:

1. Did the buzzer disturb you?
2. Did you find yourself anticipating the buzzer?
3. Did any of the syllables suggest anything to you?
CHAPTER IV

RESULTS

Eighty subjects had originally volunteered for this experiment, but the records of five of them were excluded from the analysis of the final results. Three of these subjects were dropped from the experiment because their records were incomplete. They all had missed the administration of the Nicolay-Walker PRS on the first day of their general psychology class because they were late registrants for the course. The experimenter did not discover this until it was too late to administer the PRS to them separately. The records of the other two subjects were excluded because they had colds at the time of the conditioning phase of the experiment. Since they were obviously not in good health, the experimenter felt that their conditioning records might not be valid. The results obtained in this paper have been obtained from the records of the remaining 75 subjects.

Figures 3 - 6 show the distribution of scores obtained from the subjects on both the Nicolay-Walker PRS (the total scores, the $K$ scale scores, and the scores from the three sub-scales) and the Taylor MAS.

Figure 7 shows the distribution of the GSR conditioning scores obtained from the subjects. The range of the scores is narrow, going from a low score of 3.00, which is the lowest possible score obtainable with the conditioning criterion used in this experiment, to a high score of 13.00. The mean conditioning score is 6.25, the median score is 6.33 and the mode is a score of
Fig. 3. Distribution of scores obtained by 75 male college students on the Motor Tension and Object Anxiety sub-scales of the Nicolay-Walker PRS.
Fig. 4. Distribution of scores obtained by 75 male college students on the Personal Inadequacy anxiety and K (social desirability) scale of the Nicolau-Walker PRS.
Fig. 5. Distribution of scores obtained by 75 male college students on the Total scale of the Nicolay-Walker PRS.
Fig. 6. Distribution of scores obtained by 66 male college students on the Taylor MAS.
Fig. 7. Distribution of GSR conditioning scores obtained by 75 male college students.
4.00. The standard deviation is 2.39. The distribution of the conditioning scores is asymmetrical with the majority of the cases clustered at the low and of the distribution.

Spearman rank-order coefficients of correlation were computed between the scores obtained on all of the scales of the Nicolay-Walker PRS, the Taylor MAS, and the verbal and quantitative sub-scales and total score of the College Abilities Test (Cooperative Test Division, Education Testing Service, 1955). The MAS scores were available for only 66 of the subjects. This was because some, but not all, general psychology students had been given the MAS before the experiment was begun. The College Abilities Test (CAT) scores of only 47 of the subjects used in the experiment were on record in the Dean of Admission's office of the University. The scores obtained on the CAT were used in order to determine whether intelligence, or rather scholastic aptitude, was a variable which might possibly influence rate of conditioning. All of these correlations can be seen in Table 2. None of the correlations were statistically significant at the .05 level of confidence.

Spearman rank-order correlation coefficients were also computed between the scores on the top and bottom 20% of the individuals in the distribution of scores obtained on the Nicolay-Walker PRS and the Taylor MAS and their corresponding GSR conditioning scores. The same procedure was followed for the top and bottom 25% of the individuals in the distribution of scores obtained on the CAT. This was done in order to determine whether the extremes in the distribution of the various scales' scores would yield a significant relationship with the GSR conditioning scores. This was based on the hypothesis that there might be a curvilinear relationship between the
TABLE 2

Spearman Rank-Order Correlation Coefficients Obtained Between the GSR Conditioning Scores and Scores Obtained on the Nicolay-Walker PRS, Taylor MAS and the College Abilities Test

<table>
<thead>
<tr>
<th></th>
<th>PRS (N=75)</th>
<th>CAT (N=47)</th>
<th>MAS (N=66)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PI MT OA K Total Ver. Quan. Total Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GSR Conditioning Scores</td>
<td>.07 -.13 .03 .16 -.01 -.23 -.07 -.25 .03</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

anxiety and aptitude scale scores and the conditioning scores. These correlations can be seen in Table 3. None of these correlations are significant at the .05 level of confidence.

TABLE 3

Spearman Rank-Order Correlation Coefficients Obtained Between the GSR Conditioning Scores and the Top and Bottom 20% of Scores Obtained on the Nicolay-Walker PRS and Taylor MAS and the Top and Bottom 25% of Scores Obtained on the College Abilities Test

<table>
<thead>
<tr>
<th></th>
<th>PRS (N=15)</th>
<th>CAT (N=12)</th>
<th>MAS (N=13)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PI MT OA K T V Q T Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GSR Scores</td>
<td>Top .02 -.10 -.31 .11 -.33 -.39 -.13 .43 -.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bottom -.09 .34 -.22 .25 .03 .27 .31 .02 .17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A comparison of the GSR conditioning scores obtained in the top and bottom 20% of the distribution of PRS and MAS scores showed that the largest difference obtained, in both cases (top and bottom), was between the Motor Tension (MT) sub scale and the K (social-desirability) scale. (See Table 4).

In order to determine whether or not these differences were significant, a Mann-Whitney U test was used. The differences were found not to be significant at the .05 level of confidence.

The non-parametric Spearman rank-order correlation and Mann-Whitney U test were used because the distribution of the GSR conditioning scores was asymmetrical (Siegel), 1956.

The results of the questionnaire, which included the questions "Did the buzzer disturb you?" "Did any of the syllables suggest anything to you?" and "Did you anticipate the syllable BAF," are given in Table 5.
Reactions of the Subjects to the Test Situation (in Per Cents)

<table>
<thead>
<tr>
<th>Disturbed by buzzer</th>
<th>Syllables Suggest Anything</th>
<th>Anticipate BAF</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>12</td>
<td>84</td>
</tr>
</tbody>
</table>

The majority of the subjects (90%) reported that they were disturbed by the buzzer. They also stated that at each subsequent presentation they were disturbed less and less by it. An examination of the conditioning record shows that this was the case. The meter deflection of the GSR to the buzzer became smaller with each presentation. In fact, in many cases after the buzzer had been sounded four or five times, the GSR to the critical syllable BAF was greater than when it was paired with the buzzer. Observation of the subjects showed that initially they all were startled a great deal by the buzzer. The typical startle pattern of responses could be seen. Some of the subjects literally "jumped out of the chair." These overt reactions also gradually diminished with each presentation of the buzzer. Thus, there was a gradual adaptation trend in the GSR to the buzzer with repeated stimulation every few minutes.

In an analysis of this adaptation trend of the GSR to the buzzer, the experimenter, using a randomly selected sample of 15 individuals from the experimental sample, found that complete adaptation (determined when the subject no longer gave an other than normal GSR to the buzzer) occurred in the majority of the cases after 16 presentations of the buzzer, with the range going from 13 to 20.
Some individuals (10%) stated that they were not disturbed by the buzzer. An analysis of their conditioning records, however, shows that their GSR to the buzzer was similar to that of the other subjects.

The majority of the subjects (84%) stated that they anticipated the presentation of the buzzer. This anticipation occurred primarily when the critical syllable BAF came into view. This was usually after three to four paired presentations of BAF with the buzzer. By this time the subjects began to realize that the buzzer would be sounded only when the syllable BAF came into view, and 68% (51 subjects) of them stated that after the fourth presentation of the buzzer they knew that this would occur only with every other presentation of BAF. It is interesting to note that, even though they knew the buzzer was not going to be sounded, they still gave a large GSR deflection to BAF and conditioned as readily as the other subjects.

There were a few individuals (12%) for whom certain of the nonsense syllables had some meaning. GEM reminded some of Greek, TOV of television, ZAT of ray guns, and so on. These suggestions of meaning did not appear to influence their reaction and conditioning to the critical syllable BAF.

All of the subjects expressed a great deal of interest in the experiment. About one-third of them suspected that the experimenter was not telling them the real purpose of the study, and they attempted to get at the "real reason" for the experiment. Most of the subjects wanted to know the results of their performance and whether or not they had given "normal" reactions during the experiment. None of the subjects indicated that they suspected that they were involved in a conditioning experiment.

The experimenter made no attempt to measure the intensity of the
responses to the CS (BAF) between subjects. Measures were always compared to the individual's responses to the other non-critical stimuli (the other nonsense syllables) in his record.
CHAPTER V

DISCUSSION AND CONCLUSIONS

The results of the experiment are uniformly negative - no significant relationship was found between the scores obtained on either the Nicolay-Walker PRS or the Taylor MAS and the GSR conditioning scores. In this respect the results agree with other studies which have attempted to relate rate of GSR conditioning to anxiety level as measured by a paper and pencil test of anxiety, usually the Taylor MAS (Bitterman and Holtzman, 1952; Beam, 1955; Lacey and Smith, 1955; Berry and Martin, 1957; Rephelson, 1957; Becker, 1959; Gilberstadt and Davenport, 1960). On the other hand, several studies (Welsh and Kubis, 1947; Schiff, Dougan and Welch, 1949; Bitterman and Holtzman, 1952; Gilberstadt and Davenport, 1960) have demonstrated that judgements of anxiety level by experienced clinicians on the basis of several samples of behavior are predictive in finding a significant relationship to GSR conditioning, with the high anxious subjects conditioning at a faster rate than the low anxious subjects. Other studies Lykkin, 1957; and Howe, 1958 which have found significant differences in GSR conditioning in contrasted groups, supposedly differing in terms of anxiety level, seem to add support to the results of these studies.

The results of these experiments have been used to support the contention that simple, objective, paper and pencil tests are relatively crude and insensitive measures of anxiety. The negative results obtained in this
experiment appear to lend support to this contention and also seem to indicate that the Nicolay-Walker PRS is as insensitive an instrument as the Taylor MAS in relating anxiety level to GSR conditioning. This experimenter does not believe that such a conclusion is completely justified.

Taylor and the Iowa group have shown that significant differences can be obtained between groups in the conditioning of the eyelid response, when extremes, high and low anxious, in a distribution of MAS scores are used as experimental samples. In a replication of Taylor's work, but using homogeneous samples (the total distribution of obtained anxiety scale scores) Hilgard, et al (1951) and Becker (1959) did not find a significant relationship between the two measures. In their GSR conditioning studies, Ritterman and Holtzman (1952) and Gilberstadt and Davenport (1960) used homogeneous samples and also did not find a significant relationship between the rate of conditioning and the anxiety scale scores. A homogeneous sample was also used in this experiment. This use of the total distribution of obtained scores may very well be the factor responsible for not obtaining a significant relationship between the rate of conditioning and the anxiety scale scores in this, as well as in the other experiments.

Duffy (1957) and Malmo (1953), who view anxiety as a disease of "over-activation," (or in Selye's terms, a disease of "adaptation") hold that the optimal degree of activation appears to be a moderate one and that the curve which best expresses the relationship between activation or level of anxiety and performance takes the form of an inverted U. Studies (Freeman, 1940; Lansing, et al, 1956; see also Sarason's review, 1960) would seem to confirm this hypothesis. If such a curvilinear relationship exists between
performance measures and anxiety, it is not surprising that studies which correlate the total distribution of anxiety scale scores with the conditioning measures find no significant relationship between the two.

It seems best in these kinds of studies to make comparisons between groups - extremes (high, moderate and low) isolated from the total distribution of obtained scores. Therefore, when anxiety scales are used as the sole measures of anxiety, the investigator can maximize his chances of finding real differences, if they exist, if he forms extreme groups from his obtained scores. It is this experimenter's belief that if anxiety scales are used in this way, the sensitivity of the scales is increased, and they may become good predictors in relating anxiety to variables, such as conditioning, vulnerable to it.

Although a comparison of the extremes on all the sub-scales was made in the analysis of the results of this experiment, these groups were selected from within the relatively small sample (75 subjects) used in the experiment. The range of scores, therefore, was somewhat narrow. And since as much as 20% of the top and bottom scores in the distribution was used to form the extreme groups (in order to have a large enough N to achieve significance), it hardly seems justified to consider the extremes from this sample as representative of the population. Perhaps extreme scores from a much larger sample would have yielded truly the high and low anxious individuals in the distribution and resulted in the obtaining of significant differences in conditioning rate between the groups and also the various sub-scales of the PRS.

Another factor which must also be considered is the situation in which
learning is taking place. The amount of anxiety (or "overactivation" or "adaptation" or preparation for action) displayed by an individual and measured in terms of physiological and performance measures seems commensurate with the special significance which the situation has for the individual. The "habit" interpretation of anxiety (Child, 1954; Davidson, et al., 1956; Mednick, 1957; Nicholson, 1958; Sarason, 1958b, 1959a) holds that high and low anxious subjects differ in response tendencies activated by personally threatening conditions. In a stress situation the low anxious may react with increased effort and attention to the task; whereas, the high anxious individual responds with self-oriented, personalized responses. Findings suggest that high anxious subjects are affected more detrimentally by failure reports or motivating conditions than low anxious subjects (Sarason, 1960). Ego-involved or personally threatening instructions or situations, thus, would seem to be necessary to arouse the self-oriented response tendencies in the highly anxious subject. According to the "habit" interpretation, experiments conducted under neutral or non-threatening circumstances would not find differences in performance between high and low anxious groups. Indeed, this hypothesis seems to be borne out by the findings of several investigations in which no differences are found in performance among groups differing in anxiety level when tested under neutral and apparently non-threatening conditions (Axelros, et al., 1956; Sarason, 1956a, 1957a, 1957b; Silverman and Blitz, 1956).

The Iowa group, Taylor Spence, and Farber, attribute the greater amount of conditioning in anxious subjects to the presence of greater drive strength (Hull's D) operating in these subjects. D is a function of the level of the
subject's emotionality, which in turn is assumed to be greater in anxious than in nonanxious subjects. Thus, anxiety-linked drive contributes to and becomes a part of the total general D, effecting a faster accelerating performance curve in simple tasks. Hilgard, et al., (1951) and Bindra, et al., (1956) disagree with this interpretation of anxiety. They hold that the differences in conditioning obtained between high and low anxious subjects are the results of a higher degree of "specific defensive drive" operating in highly anxious subjects. This distinct and specific defensive drive is brought out only when a threatening stimulus, such as an air puff to the eye (resulting in a defensive eyelid response) or an electric shock to the wrist (resulting in a defensive withdrawal), is used as the UCS in conditioning experiments. Under these conditions, anxious subjects, being more apprehensive, make more defensive and protective responses and, therefore, make conditioned responses more readily than non-anxious subjects. To test this interpretation Bindra, et al., (1956) conditioned a non-defensive response, salivation, in high and low anxious subjects selected from a distribution of Taylor MAS scores. The results confirmed their hypothesis, no difference in rate of conditioning was found between the groups. To this writer's knowledge, this is the only experiment carried out to test specifically this interpretation of anxiety.

In the present experiment, the UCS was a loud raucous buzzer - a stimulus which disturbed the subjects a great deal, eliciting the typical startle reaction pattern of responses. However, the subjects did show a gradual adaptation of their GSR to the stimulus. This adaptation could have been avoided if the intensity or duration of presentation of the buzzer, or both,
were randomly varied during the experiment. Since at the time, the subjects
did condition readily, fulfilling the conditioning criterion, this adaptation
trend did not seem important. But in effect the buzzer was becoming less and
less noxious and more and more non-defensive with each presentation. Also,
no personal threats were implied in the instructions, and all attempts were
made to get the subjects to relax as much as possible during the experimental
session (this was done to enable the experimenter to get an accurate reading
of the GSR to the UCS and CS).

Thus, the experimental design was such that it went counter to the
recommendations of both the "habit" and "defensive drive" interpretations of
anxiety. If either of these interpretations is correct, this may yet be
another reason why negative results were obtained in this experiment.

The fact that the GSR quickly adapts to any stimulus repeated continuously
every few minutes may make it a valuable tool in differentiating high and low
anxious individuals. Mundy-Castle, et al, (1953) found that subjects who
showed a large number of GSR's when there were no observable stimuli also
showed less adaptation of the GSR to repeated stimulation. This is the kind
of behavior that would seem to be typical of hyperactive, highly anxious
individuals. However, in this study Mundy-Castle, et al, made no attempt to
measure anxiety level differences between the subjects. It would be interest-
ing to see if there are differences in rate of adaptation of the GSR to a
repeated stimulus in groups differentiated in terms of anxiety. This is an
area which seems worthy of investigation.

In conclusion, this writer suggests that, although the results of the
experiment were negative, this may not be entirely due to the anxiety
measures used, but also to the design of the experiment. Future experiments, in which anxiety scales are used to relate anxiety level to performance measures, such as rate of conditioning, should probably use the extremes in the total distribution of obtained scores, drawn from a large sample, as the experimental groups. Various experimental treatments should also be used to gauge the effect of stress (personally threatening situations) versus non-stress on the performance of groups differing in anxiety level. The effectiveness of the selection of experimental samples on the basis of specific tests of anxiety, such as the Nicoll-Walker PSS and Sarason Test Anxiety Scale, versus general indices, such as the Taylor MAS, will also have to be compared. And attempts should be made to test the hypotheses of the various "interpretations" of anxiety. All of this is being done now in varying degrees, but the results obtained so far are conflicting and contradictory. This is probably because the work is being carried out by individuals who are not entirely unbiased in their approach to the problems. A program of research involving all of these variables could easily be designed and carried out; and, if well designed, such a program could clear up much of the confusion surrounding the term anxiety, anxiety scales, and the effect of anxiety level upon performance.

This writer also suggests that much of this research be carried out using the conditioning of the GSR because it is relatively involuntary, readily conditioned and seems to be one of the best measures of activation or arousal available (Lindsley, 1951; Woodworth and Schlosberg, 1954). In this regard, the conditioning should be measured in terms of response amplitude changes and rate of extinction, as well as conditioning criterion scores.
CHAPTER VI

SUMMARY

Several studies have found a significant relationship between GSR conditioning and level of anxiety, with high anxious subjects conditioning at a faster rate than low anxious subjects. These studies have used both homogeneous and contrasted groups as experimental samples, and the anxiety level of the subjects has been assessed on the basis of clinical judgements. On the other hand, studies in which anxiety level has been assessed by a paper and pencil test of anxiety have not found a significant relationship between the anxiety scale scores and the rate of GSR conditioning. This has been attributed to the "insensitivity" of psychometric indices of anxiety.

This study was an investigation into the relationship between anxiety scale scores and GSR conditioning scores. The anxiety scale scores were obtained from the administration of the Nicolay-Walker Personal Reaction Scale (PRS), which has been developed on the basis of factors isolated from the Taylor Manifest Anxiety Scale (MAS), and the MAS. It was hypothesized that the PRS would relate significantly better than a general index of anxiety (such as the MAS) to a dependent variable, the conditioning of the GSR to a noxious stimulus, vulnerable to anxiety because it has been constructed to measure three pure types of anxiety - motor tension, personal inadequacy, and object anxiety.

However, negative results were obtained - no significant relationship
was found between the GSR conditioning scores and the scores obtained on either the PRS or the MAS anxiety scales. These negative results were attributed to both the design of the experiment and the anxiety measures used.
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The dissertation submitted by Frank J. Macchitelli has been read and approved by five members of the Department of Psychology.

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the dissertation is now given final approval with reference to content, form, and mechanical accuracy.

The dissertation is therefore accepted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

June 1, 1964

Date

Signature of Adviser