ABSTRACT

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This study examines the performance of women on a novel fine-motor task, specifically, mirror-tracing, under non-anxious and anxious-induced conditions. Threat of electric shock is used to induce anxiety. Also, this investigation seeks to determine whether A-State is related to heart rate response, and task-performance condition. Initially, 122 female undergraduates at UNC-G volunteered to respond to the A-Trait scale of the STAI (State-Trait Anxiety Inventory). On the basis of their A-Trait scores, 46 Ss were classified as HA, and 41 were classified as LA. Those who were classified as moderately-anxious were excluded from further participation in the study. Thus, 87 Ss participated in the experiment. Of these, 23 HA Ss worked in the anxious-induced condition, and the other 23 HA Ss worked in the non-anxious condition. Meanwhile, 21 LA Ss worked in the anxious-induced condition, while the remaining 20 LA Ss worked in the non-anxious condition. Prior to task performance each S responded to the A-State scale of the STAI. Subsequently, baseline EKG readings were recorded. As each S executed the task, heart rate, number of errors, and time to complete the task were recorded.

Some of the results showed consistent trends supporting the Trait-State Theory of Anxiety. Principally, Ss who worked in the non-anxious condition performed significantly ($p < .05$) better than those Ss who worked

in the anxious-induced condition. HA Ss who worked in the anxious-induced condition performed more poorly than their LA counterparts who worked in the non-anxious condition. However, LA Ss did not perform better than HA Ss when working under the anxious-induced condition. Also, no difference in performance was found between HA and LA Ss while working under the non-anxious condition. The measurement of heart rate change did not prove to be a reliable indicator of A-State arousal. Also, no relationship was found between A-State and performance, although a trend suggesting performance decrement occurring in a stressful situation was shown. In effect, partial support was found for the theoretical prediction that A-State is related to poor performance.

PERFORMANCE OF A NOVEL TASK

UNDER TWO CONDITIONS

OF ANXIETY

by

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CHAPTER I

Introduction

Fear and anxiety have long been regarded as fundamental human emotions. In his classic book, The Meaning of Anxiety, May (1950) considers the evidence of the centrality of the problem of anxiety in contemporary literature, music, art, and religion, as well as in psychiatry, psychoanalysis, and psychology. He also documents the concern for anxiety in current political and philosophical thought.

In the twentieth century, the importance of anxiety as a fundamental human emotion has been widely recognized by behavioral and medical scientists, and by learning theorists. Many individuals regard anxiety as a basic condition of human existence (Spielberger, 1972).

Since 1950, more than 2,500 articles and books have been indexed in Psychological Abstracts under the heading "Anxiety". Thus, the behavioral scientist who wishes to study anxiety is confronted not only with a burgeoning of empirical studies, but also with a diversity of theoretical orientation that reflect important differences in the professional training, experience, and research goals of those who work in this area.

In adherence to one particular conception of "anxiety" the present study concerns the specific effect that this phenomenon might have in an individual's performance on a novel, fine-motor task.

Statement of the Problem

The following questions formed the framework for the design, data gathering, and analysis of this study:

1. Do subjects who work under a non-anxious condition perform with more speed and accuracy on the mirror-training task than subjects working under an anxious-induced condition?
2. Do high-anxious subjects perform with more speed and accuracy on the mirror-tracing task than the low-anxious group of subjects when both groups are working in the non-anxious condition?
3. Do low-anxious subjects perform with more speed and accuracy on the mirror-tracing task than the high-anxious group of subjects, when both groups are working under the anxious-induced condition?
4. What is the relationship, if any, between state anxiety and the physiological parameter -- heart rate?
5. What is the relationship, if any, between state anxiety and performance on a novel task in an anxious-induced condition, and in a non-anxious condition?

Definition of Terms

For interpretation in this study, the following meanings are intended for terms indicated:

Anxious-induced condition -- elicited by the presence of the psychological stressor.

Non-anxious condition -- absence of the psychological stressor.

STAI -- the State-Trait Anxiety Inventory, a forty item self-evaluation questionnaire.

Baseline recordings -- the physiological parameter of heart rate, as interpreted from electrocardiogram tracings.

Naive subjects -- subjects who have never had any prior experience in executing the mirror-tracing task.

Novel task -- the mirror-tracing task.

Performance -- the score on the mirror-tracing task based on the following formula:

$$\text{score} = \frac{100}{\text{time to complete task} + \text{number of errors}}$$

Psychological stressor:

(1) Auditory warning -- electric bell

(2) Threat of electric shock

State anxiety (A-state) -- a transitory emotional state or condition as measured by the STAI.

Trait anxiety (A-trait) -- an acquired behavioral disposition which predisposes an individual to manifest object-consistent responses, and is measured by the STAI.

Assumptions

Underlying this investigation are the following assumptions:

1. The STAI validly dichotomizes high and low-anxious subjects.
2. The threat of electric shock arouses anxiety.
3. The mirror-tracing task has never been performed by subjects previously.

Scope of the Study

This investigation is limited by the sampling and classification procedures. Heterogeneity of the sample is established by the selection of female college undergraduates participating in physical education activity service classes conducted by the School of HPER of the University of North Carolina at Greensboro in the Spring Semester of 1973. Classification of the subjects as high-anxious or low-anxious is determined by scores on the STAI. The final delineating factor in this investigation is the physical environment, including the specific equipment used in data gathering -- the Rosenthal Laboratory at the University of North Carolina at Greensboro, the mirror-tracing task itself, the physiograph-four, an electric counter and, a stopwatch.

Significance of the Study

To date, a survey of the literature has revealed only limited information concerning the performance of anxious female subjects on novel motor tasks. Relatively little scientific evidence exists concerning women's performance under anxious-induced conditions and non-anxious conditions. Data about the execution of precise motor tasks that is collected in the controlled setting of the laboratory may be utilized in comparing activity effects that occur in other conditions. With the increased participation of women in athletics as well as other endeavors, a data base for women's skilled responses needs to be established. Further, the conflicting results reported in studies of the physiological correlates of anxiety also indicates the need for further laboratory data about women.

CHAPTER II

REVIEW OF THE LITERATURE

The role of anxiety as an influence in our society is receiving increased recognition (Cattell, 1963). Manifestations of current concern with anxiety phenomena are ubiquitously reflected in literature, the arts, science, religion, and sports spectacles, as well as in many other facets of our culture. Yet, despite the prevailing consensus as to significance, there seems to be little agreement among authorities as to the exact nature of the phenomenon. This has, in turn given to ambiguities in the various conceptualizations of anxiety theory. It is not surprising therefore that research about anxiety is characterized by semantic confusion and contradictory findings (Spielberger, 1966).

Theories of Anxiety

Early points of view. As early as 1880, James and Lange (1890) perceived that experienced physiological phenomena do not cause emotion, nor are they the results thereof. Rather, visible and sensible bodily changes make possible the emotional experience. Conversely, Canon (1927) demonstrated that animals surgically deprived of all autonomic reactivity were still capable of manifesting emotional behavior. Canon and Bard (1929) showed that affective experiencing and the behavior that clearly expressed its occurrence were not directly a function of autonomically induced bodily changes. However, they suggested that both effective experience and autonomic reactivity arise concurrently.

The Canon-Bard theory therefore asserts that anxiety, in fact all emotions, are the effects of stimulus conditions originating in the environment and mediated through specific structures of the central nervous system.

Freud is undoubtedly one of the most important contributors to our present understanding of anxiety phenomena (Spielberger, 1972). Freud (1924) first attempted to explicate the meaning of anxiety within the context of psychological theory. He regarded anxiety as an unpleasant state or condition. This state, as observed in patients with anxiety-neurosis, was characterized by all that is encompassed by the word "nervousness", apprehension or anxious expectation, and efferent discharge phenomena. In his early theoretical formulations, Freud acknowledged that anxiety resulted from the discharge of repressed unrelieved somatic sexual tensions (libido). He later modified his view, emphasizing the ego, and conceived of anxiety as a signal indicating the presence of a danger situation (Fischer, 1970). Freud differentiated between objective anxiety and neurotic anxiety, largely on the basis of whether the source of the danger was from the external world or from internal impulses. Thus, for Freud, anxiety was not only a central problem in neurosis, but understanding anxiety was also essential to the development of a comprehensive theory of human behavior. Freud's theoretical views about fear and anxiety were continually modified over a period of nearly fifty years as he attempted to delineate and clarify ideas with which to explain the essential nature of these concepts (Spielberger, 1972).

Hull's (1943) theoretical conceptualization was named Drive Theory. This theory proceeds from the basic assumption that the excitatory potential (E), that determines the strength of a given response (R), is a multiplicative function of total effective drive state (D) and habit strength (H). In addition, the theory assumes that the level of D is a function of the magnitude of a hypothetical mechanism, a persistent emotional response aroused by aversive stimuli. Based on deductions from the observations that individuals differ in the magnitude of their response to a given intensity of noxious stimulation, Hull assumes that individuals vary in the magnitude of emotional response and, therefore, in level of D under a given set of experimental conditions.

Since the turn of the century, clinical studies have appeared in the psychiatric literature with increasing regularity (Spielberger, 1972). Prior to 1950, however, there were relatively few experimental investigations of anxiety in humans. The complexity of anxiety phenomena, the lack of appropriate instruments for assessing anxiety, and ethical problems associated with inducing anxiety in the laboratory have all contributed to the paucity of research (Spielberger, 1966).

Current conceptualizations. Theory and research about anxiety were greatly stimulated in 1950 by the publication of two important books: May's The Meaning of Anxiety, and Mowrer's Learning Theory and Personality Dynamics. According to May (1950), anxiety was the apprehension triggered by a threat to some value which the individual holds essential to his existence. While the capacity to experience anxiety was considered to be innate, the particular events or stimulus conditions which evoked it were, according to May, largely determined by learning.

As an alternative to Freud's "impulse theory" of anxiety, Mowrer (1950) proposed a "guilt theory" of anxiety. He contended that anxiety comes not from acts that the individual would commit but dares not, but, rather, from acts which he has committed but wishes he had not. Thus, neurotic anxiety was assumed to result from the repudiation of the demands of the conscience, not the instincts. For Sullivan (1953), however, anxiety was an intensely unpleasant state of tension arising from experiencing disapproval in interpersonal relations. Once aroused, anxiety distorts the person's perception of reality, limits the range of stimuli that are perceived and causes those aspects of the personality that are disapproved, to be dissociated.

Interest in anxiety phenomena was further stimulated at mid-century by the research and subsequent development of Taylor's (1951, 1953) Manifest Anxiety Scale (MAS), and Mandler and Sarason's (1952) Test Anxiety Questionnaire (TAQ) -- the first of a number of psychometric instruments designed to assess fear and anxiety in adults.

In general, since Freud's conception of anxiety as "something felt", an unpleasant affective state or condition of the human organism, anxiety has been regarded as an emotional state. Anxiety, according to Freud (1936), could be distinguished from other unpleasant affective states, such as anger, grief, or sorrow, by its unique combination of experiential and physiological qualities.

Currently, the term "anxiety" is most commonly used in contemporary psychology to denote a palpable but transitory emotional state or condition characterized by feelings of tension and apprehension and heightened autonomic nervous system activity (Spielberger, 1972).

Research about anxiety as an emotional state has focused upon delineating the general properties of transitory anxiety states and identifying the specific conditions that evoke them (Fischer 1970). On the basis of an extensive review of the literature in psychology and psychiatry, Krause (1961) concluded that transitory anxiety is typically inferred from : (1) introspective verbal reports, (2) physiological signs, (3) molar behavior (i.e. body posture, restlessness, distortions in speech), (4) task performance, (5) clinical intuition, and (6) response to stress.

Basowitz et al, (1955), define anxiety as the conscious and reportable experience of intense dread and foreboding, conceptualized as internally derived and unrelated to external threat. They also posit, as did Freud, that the unpleasant phenomenological qualities associated with anxiety states are consciously experienced. Thus, an individual who is "anxious" can observe and describe his unpleasant feelings, and can report the intensity and duration of these feelings.

In contrast to Krause's emphasis on introspective reports in the definition of anxiety, Martin (1961) proposes that anxiety reactions be viewed as complex neurophysiological responses that must be distinguished, conceptually and operationally, from the external or internal stimuli that evoke these responses. Thus, Martin emphasizes the importance of identifying and measuring the observable physiological and behavioral response patterns associated with states of fear or anxiety, and of differentiating between anxiety states and other emotional reactions.

Schachter (1964) presents impressive evidence that emotional states consist of two major components: (1) physiological arousal, and (2) socially determined cognitions. According to Schachter, an individual labels the feeling states associated with physiological arousal in terms of the social interpretations he gives to the situations in which these states are experienced. With regard to the natural occurrence of fear as an emotional reaction, Schachter suggests that cognitive or situational factors trigger physiological processes, and the triggering stimulus usually imposes the label we attach to our feelings. We see the threatening object; this perception - cognition initiates a state of sympathetic arousal and the joint cognitive - physiological experience is labeled "fear".

Cattell and Scheier (1961), in their factor analytic research, accounted for phenomenological and physiological variables presumed to be related to anxiety. In this multivariate approach, "state and "trait" anxiety have consistently emerged as principal personality factors. Cattell hypothesized that it should be possible to assess both state and trait anxiety from a single personality questionnaire, by applying different weights to each item according to its unique contribution to the state and trait factors.

Singer (1968) argues that the conceptual ambiguities of anxiety which exist are due to the more or less indiscriminate use of the term to refer to two very different types of concepts: (1) a transitory state, and (2) a personality trait. Spielberger (1966) notes that, although there has been progress in the assessment of personality characteristics in the past two decades, most of the advances have occurred in the measurement of personality traits rather than in the evaluation of psychological states.

Thorne (1966) has cogently argued that psychological states should be the basic units of measurement in the study of human behavior and especially in the study of personality. But because of methodological difficulties, transitory states have been largely ignored in psychological research. An adequate theory of anxiety, must distinguish conceptually and operationally between anxiety as a transitory state and, or, a relatively stable personality trait. It was also apparent to Spielberger (1966) that a comprehensive theory of anxiety must differentiate between anxiety states, the stimulus conditions that evoke these states and the defenses that serve to avoid or ameliorate them.

Deriving from this point of view, then, and supported by empirical evidence favouring Spence's (1958) Reactive Hypothesis (Nicholson, 1958; Sarason, 1960; Spence and Spence, 1966; Spielberger, 1966), Spielberger (1966) conceptualized two distinct factors: (1) trait anxiety, and (2) state anxiety. State anxiety (A-State) is perceived as a transitory emotional state or condition of the human organism that varies in intensity and fluctuates over time. This condition is characterized by subjective, consciously perceived feelings of tension and apprehension and activation of the autonomic nervous system. The level of A-State, therefore, should be high in circumstances that are perceived by an individual to be threatening, irrespective of the objective danger. Conversely, A-State intensity should be low in nonstressful situations, or in circumstances in which an existing danger is not perceived as threatening.

Trait anxiety (A-Trait) refers to relatively stable individual differences in anxiety proneness; that is, to differences in the disposition to perceive a wide range of stimulus situations as dangerous or threatening, and in the tendency to respond to such threats with A-State reactions. A-Trait may also be regarded as reflecting individual differences in the frequency and the intensity with which A-States have been manifested in the past, and in the probability that such states will be experienced in the future. According to Spielberger's theory, persons who are high in A-Trait tend to perceive a greater number of situations as dangerous or threatening than persons who are low in A-Trait. They tend to respond to threatening situations with A-State elevations of greater intensity.

Essentially, the Trait-State Theory provides a conceptual frame of reference for classifying the major variables that are usually considered in anxiety research. Furthermore, it suggests possible interrelationships among these variables. The theory is especially concerned with clarifying the properties of A-State and A-Trait as stimulus conditions which evoke differential levels of A-State in persons who differ in A-Trait. Spielberger's theory also recognizes the centrality of cognitive appraisal in the evocation of an anxiety state, and the importance of cognitive and motoric processes (defense mechanisms) that serve to eliminate or reduce anxiety states (Spielberger, 1972).

Measurement of Anxiety

Physiological. Conceptually, anxiety has been regarded as a complex emotional process. In his early writings, Freud (1917) posited that the phenomenological component of anxiety resulted from perceptions of motor innervations that have occurred, and direct feelings of pleasure and unpleasure. Taylor (1956) and Spence (1958) conducted extensive research into anxiety based on Hull's (1943) Drive Theory, while May (1950) conceived of anxiety as diffuse apprehension, differing from fear in its vagueness and objectlessness. And Spielberger (1966) and Levitt (1967) essentially equated anxiety with fear. More recently, Spielberger (1972) referred to anxiety as "complex emotional reactions", although he continued to emphasize the fear or fear-like component of anxiety.

Izard (1971) defined emotion as a complex concept that has neurophysiological, motor-expressive, and phenomenological aspects. This contention that any fundamental emotion has a motor or neuromuscular component and, further, that this component is of crucial importance in the feedback and component interactional process of emotion and behavior is supported by the research of Malmo (1966) and his colleagues -- which has shown that psychiatric patients tend to have somewhat higher muscle tension levels than normal persons.

Earlier, Malmo (1957) employed physiological methods in an attempt to clarify the confusion surrounding the concepts of motivation, emotion, and anxiety. He found that measures such as steepness of muscle-potential gradients and level of palm or skin conductance were careful indicants of arousal level. Martin (1961) focused his attention on the assessment of anxiety by physiological - behavioral measures. He found that those measures most closely associated with anxiety level were: systolic blood pressure, heart rate changes, galvanic skin response, and respiratory rate.

Based upon careful review of research about psychophysiology, Ax (1964), offered a point of view which considered abstracted goals and methods of psychophysiology. As far as he was concerned, it is the central purpose of a theory of anxiety to describe the mechanisms which translate actions and effects from one system to the other. The specific goals of a theory are to identify and describe the physiological constructs as drive, motivation, attitude, emotion, and their modification by learning.

Harleston, Smith, and Arey (1965) attempted to identify physiological correlative evidence of test anxiety in a problem-solving situation. The principal findings were that high-anxious subjects produced significantly larger increases in heart rate with the onset of the problem-solving task than low-anxious subjects.

Funkenstein, Greenblatt, and Solomon (1951, 1952) concluded that patients with anxiety and depressive symptoms manifest a chronic epinephrine-like reaction, whereas patients with paranoid tendencies or who otherwise direct their anger and blame upon the external world, manifest a chronic norepinephrine-like reaction. Kelley, Brown, and Shaffer (1970) set out to determine how a group of subjects considered to be normal control differed from a group of anxious patients on a battery of parameters in a single blind-design investigation. They found that resting forearm bloodflow and heart rate correlated significantly with clinical and subjective ratings of anxiety.

Through their work with factor analytic techniques, Cattell (1963) and Cattell and Scheier (1961) found more rapid conditioning of autonomic responses with higher anxiety. Those autonomic responses found to be indicative of high anxiety were high heart rate, raised cholinesterase, high steroid hormone level, high systolic pulse pressure, and less alkaline saliva.

Carron (1971) and Spielberger (1971) seem to have summarized, in a general way, the issue of physiological measurement of anxiety. They have both pointed out that definite patterns of physiological responses are, in fact, associated with anxiety phenomena.

Psychological. Spielberger (1972) notes that, although there has been notable progress in the assessment of personality characteristics in the past two decades, most of the advances occurred in the measurement of personality traits rather than in the evaluation of psychological states. Since personality traits and states reflect different psychological constructs, the conceptual differences between them must be clarified in order to give meaning to a discussion of the measurement of state anxiety.

Thorne (1966), regards personality states as temporal cross sections in the stream-of-life of a person. A personality state exists at a given moment in time, and at a particular level of intensity. Further, Thorne (1966) suggests that although personality states are often transitory, they can recur when evoked by appropriate stimuli, and they may endure over time when the evoking conditions persist. Emotional reactions, therefore, may be viewed as expressions of personality states.

In contrast to the transitory nature of personality states, personality traits may be conceptualized as relatively enduring individual differences among people. These are revealed in specifiable tendencies to perceive the world in a certain way and also in dispositions to react or behave in a specified manner with predictable regularity

(Spielberger, 1972). Personality traits have the characteristics of a class of constructs which Atkinson (1964) calls "motives", and which Campbell (1963) refers to as "acquired behavioral dispositions". Personality traits may also be regarded as reflecting individual differences in the frequency and the intensity with which certain emotional states have been manifested in the past, and the differences in the probability that such states will be experienced in the future (Spielberger, 1972). Furthermore, the stronger the personality trait, the more likely it is that these emotional states and associated behaviors will be characterized by high levels of intensity.

Thorne (1966) stressed that psychological states should be the basic units of measurement in the study of human behavior, expecially in the study of personality. However, because of methodological difficulties, transitory states have tended to be ignored in psychological research. Over the past decade, a number of investigations have developed structured self-report scales that show promise as measures of transitory moods and emotional states. Spielberger (1972) notes that self-report scales are subject to falsification through a variety of mechanisms, and that response sets often operate to distort the scores obtained with verbal report measures. It must be recognized, therefore, that the use of self-report scales to measure personality states relies upon the acceptance of what Wilde (1972) termed the "inventory premise" -- the assumption that people are willing and able, to correctly describe their own feelings and behavior.

One of the first comprehensive batteries of self-report scales for the assessment of feelings was developed by Hildreth (1946). From the verbal reports of military patients, he derived 175 phrases that typified moods and attitudes, and classified these into six categories. The result was the Hildreth Feeling and Attitude Battery, a set of scales that measured various moods and affect states

On the basis of Hull's (1943) Drive Theory, Janet Taylor (1953) developed the Manifest Anxiety Scale (MAS) to measure emotionally based drive. This became an extremely popular instrument. Briefly, Drive Theory posits two assumptions: (1) noxious or aversive stimuli arouse a hypothetical emotional response, and (2) drive level (D) is a function of the strength of the emotional response. Therefore, the MAS was designed as an operational measure of the emotional response, and it was assumed that scores on this scale reflect consistent individual differences in D. Evidence of the construct validity of the MAS as an index of D has been consistently demonstrated in classical conditioning experiments in which the unconditioned stimulus is typically a noxious stimulus (Spence, 1964).

Wessman and Ricks (Wessman, Ricks and Tyl, 1960; Wessman and Ricks, 1966) used rational and clinical criteria to develop a number of "Personal Feeling Scales", which defined bi-polar affect dimensions such as tranquility versus social contempt, personal feeling versus constraint, harmony versus anger, energy versus fatigue, and others. The Wessman-Ricks and Hildreth scales are cumulative scales in that the items are ordered to reflect increasing intensities of a particular feeling state (Stouffer et al, 1950).

In the mood scales developed by Wessman and Ricks, state anxiety is measured by a single, ten-item cumulative scale. Subjects are required to indicate "how calm or troubled you feel", by checking one of the ten items. Wessman and Ricks were primarily concerned with the elation-depression dimension, and they report only limited information with regard to the validity of their anxiety scale (Wessman and Ricks, 1966).

A rather different approach to the measurement of affective states was taken by Nowlis and Green (Green and Nowlis, 1957; Nowlis and Green, 1964; Green, 1964). They collected a large number of adjectives that could be used to complete the sentence, "I feel ______." On the basis of factor analytic studies, scales were derived for measuring twelve different mood dimensions. Unfortunately, the range and reliability of these scales is limited by the fact that many of the dimensions are defined by as few as three adjectives, and one dimension is assessed by only two adjectives.

An anxiety factor emerged as one of the basic mood dimensions in the research of Nowlis and Green (1965). This factor was defined by the adjectives "clutched up", "fearful", and "jittery". Other adjectives that also had loadings on the anxiety factor were "apprehensive", "uncertain", "helpless", and "weak", but the findings for these adjectives were not entirely consistent.

The IPAT 8-Parallel Form Anxiety Battery (8-PF) was developed by Scheier and Cattell (1960) for the repeated measurement of changes in anxiety level over time. Each of the eight forms of this battery consists of subtests for which high loadings on a state-anxiety factor were demonstrated in differential-R and P-technique factor analysis. Only limited validity data have been reported for this test as a measure of state anxiety (Barrett and Dimascio, 1966; Dimascio, Meyer, and Stifler, 1968).

It should be noted that most of the data in the 8-PF Anxiety Battery were taken from the Objective-Analytic (O-A) Anxiety Battery (Cattell and Scheier, 1960) which measures trait anxiety as defined by Factor U.I. 24 (Cattell and Scheier, 1961).

Zuckerman and his associates (Zuckerman 1960; Zuckerman and Biase, 1962; Zuckerman et al, 1964) developed the Affect Adjective Check List (AACL) to measure both state and trait anxiety. The AACL was subsequently extended to include measures of hostility and depression, and renamed the Multiple Affect Adjective Check List (MAACL). State anxiety is measured with the "Today" version of the AACL. This form requires the subject to check those adjectives that describe how he feels on the particular day the test is administered. While evidence for the validity of the Today Form of the AACL as a measure of state anxiety is impressive, the General Form of the AACL typically shows lower correlations with other standard measures of trait anxiety (e.g., the Taylor Manifest Anxiety Scale and the IPAT Anxiety Scale) than these measures correlate with one another (Spielberger, Gorsuch, and Lushene, 1970).

Spielberger (1966), from an evaluation of research literature on anxiety, found that high trait-anxiety subjects tended to show performance changes attributable to higher drive (D) in situations characterized by psychological stress. Assuming that elevations in state anxiety reflect drive level, drive theory delineates the complex effects of differences in state-anxiety (D) on performance. According to the theory, the effects of state anxiety on performance in a learning task depend upon the relative strengths of the correct habits (responses) and the competing error tendencies evoked by the task. Based upon these contentions, Spielberger, Gorsuch, and Lushene (1969) developed the State-Trait Anxiety Inventory (STAI) to provide reliable, relatively brief self-report measures of both state (A-State) and trait (A-Trait) anxiety. Since most anxiety scales measure trait anxiety (Spielberger, 1966), a large number of items embodying content of proven relationship to the most widely used A-Trait scales were rewritten so that each item could be administered with different instructions to measure either A-State or A-Trait. However, because of the psycholinguistic properties of some of the items, i.e., the connotations of key words in these items conveyed meanings that interfered with their use as measures of both A-State and A-Trait, the test construction for the STAI was modified to develop separate scales for the measurement of A-State and A-Trait.

The STAI A-Trait scale consists of twenty statements that ask people to describe how they generally feel. Subjects are required to respond to each scale item (e.g. "I lack self-confidence") by checking one of the following: "Almost never", "Sometimes", "Often", "Almost always".

Individual items were originally selected for the A-Trait scale on the basis of significant correlations with other anxiety scales that are widely accepted as measures of individual differences in A-Trait, e.g., the Taylor MAS, and the IPAT Anxiety Scale. Individual A-Trait items were also expected to be impervious to situational stress and relatively stable over time (Spielberger, 1966). With regard to the origin of individual differences in A-Trait, it is assumed that residues of past experience dispose high A-Trait subjects to appraise situations that involve some form of personal evaluation as more threatening than do subjects who are low in A-Trait (Spielberger, 1971).

Three important characteristics determined the test construcion strategy for the development of the STAI A-State scale. First, when the scale was given with instructions that required the subject to report his present feelings ("Indicate how you feel right now"), each item was expected to reflect the subject's level of anxiety (A-State) at that particular moment in time. Only those items were retained for the final scale that showed higher means in *a priori* stressful situations than in nonstressful or nonthreatening situations.

A second characteristic that was sought in the development of the STAI A-State scale was high reliability. In evaluating the effects of various stressor conditions on level of A-State, the major interest was to consider the differences obtained on two or more occassions of measurement. Since different scores between any two occassions contain the error components of both the initial and final scores it was reasoned that low reliability would be obtained if the components of the difference score were only moderately reliable.

To maximize its use in psychological research, a third characteristic that was desired in the STAI scale was ease and brevity of administration. Since rapid fluctuations in A-State may occur in a changing environment, a long test would be less sensitive to such variations.

The STAI A-State, like the A-Trait scale, consists of twenty statements. However, they ask people to describe how they feel at a particular moment in time. Subjects respond to each A-State item by rating themselves on the following four point scale: (1) Not at all, (2) Somewhat, (3) Moderately so, (4) Very much so. The essential qualities that are evaluated by the STAI A-State scale involve feelings of tension, nervousness, worry, and apprehension. In developing the A-State scale it was discovered empirically that such feelings were highly correlated with the absence of feelings of calmness, security, contentedness, and the like. Therefore, such items as "I feel calm", and "I feel content", were included to produce a balanced A-State scale; half of the items relate to the presence of apprehension, worry, or tension, and the remaining items reflect the absence of such states. Thus, the STAI A-State scale defines a continuum of increasing levels of A-State intensity, with low scores indicating states of calmness and serenity, intermediate scores indicating moderate levels of tension and apprehensiveness, and high scores reflecting states of intense apprehension and fearfulness that approach panic.

When administered for research purposes, the STAI A-State scale may be given with instructions that focus upon a particular time period. In clinical research, a patient may be asked to report the feelings he experiences in therapy interviews or how he felt while he visualized a specific stimulus situation in a behavior therapy session.

In order to measure changes in the intensity of transitory anxiety over time, the STAI A-State scale may be given on each occassion for which an A-State measure is needed. Multiple repeated measures of A-State may be obtained either with the same or with different instructions as to the time period for which the subjects reports are desired. For example, a subject may be asked to report how he feels immediately before he begins to work on an experimental task (Spielberger, 1972).

Correlations with other measures of A-State, such as the Zuckerman AACL, Today Form, provide evidence of the concurrent validity of the STAI A-State scale (Spielberger et al, 1970). Additional evidence of the construct validity of the STAI A-State scale may be found in recent studies by Auerbach (1971), Edwards (1969), Hall (1969), Hodges (1967), Hodges and Felling (1970), Lamb (1969), Lushene (1970), McAdoo (1969), O'Neil (1969), O'Neil et al. (1969), Parrino (1969), Spielberger et al (1972), and Taylor, Wheeler and Altman (1968).

In summary, it was pointed out that the failure to make the conceptual distinction between state and trait anxiety has led to the inappropriate use of operational measures of A-State and A-Trait. This contributed to inconsistent and contradictory findings in investigations of anxiety and motor behavior, as well as in other areas of anxiety research. The most serious methodological flaws in anxiety-motor behavior research, as noted by Martens (1971), are: (1) the use of A-Trait scales to measure transitory anxiety, and (2) the common practice of failing to obtain measures of A-State to corroborate the effects of experimental manipulations designed to be stressful.

The value of future research about anxiety and motor behavior would seem to depend upon the development of appropriate motor tasks in which it is possible to assess the relative strength of correct and competing tendencies. Therefore, in investigations of the effects of stress on motor behavior, measures of A-State should be obtained in the experimental situation. Finally, as suggested by Spielberger (1972), since general A-Trait measures have not proved too effective in predicting changes in motor behavior, it might be desirable to develop A-Trait measures that are designed to assess individual differences in the disposition to respond with differential A-State reactions in motor behavior situations.

Selected Research Reports

Anxiety and motor task performance. Motor skills have been used in experiments designed to measure learning and performance (Grose, 1967; Henry, 1959, 1961; Henry and Welch, 1967; Morford, 1966).

Dunham (1970) studied the effect of twenty-four days of practice on the relationship between individuals' performances of two motor skills -- pursuit-rotor and mirror-tracing. The results indicated that intertask correlations computed for each day were generally low and performance improvement was significant for both tasks at the .01 level. An important matter of concern in Dunham's study is the manner in which the subjects' scores were determined on the mirror-tracing task -- the score equalled the product of total time required to complete the pattern and the number of errors made, total time was recorded as the score.

Earlier, Drowatzky (1969) evaluated selected measures representing performance on a mirror-tracing task in an attempt to locate a measure which would best indicate the amount of learning occurring during performance. The author concluded that evaluation of mirror-tracing performance should take into consideration the measures of completion time, errors per trial, and the product of time and errors.

Martens and Landers (1969) studied the effect of anxiety on learning and performance of a complex motor task. In addition, the effects of two stressors -- competition and failure, and the interactions between these stressors and anxiety were investigated. The results showed that subjects low in anxiety performed significantly better than subjects high in anxiety during the initial learning of the task. No difference was found between subjects extreme in anxiety once the task was well-learned. Competition and failure did not affect performance or interact with the anxiety level of subjects.

Ausubel, et al. (1953) investigated qualitative changes in the learning process attributable to anxiety. High and low anxiety groups were constituted on the basis of Rorshach Anxiety scores. A significant difference between these two groups, in anxiety, was obtained on the Illinois Personality Inventory. The results showed the low-anxiety group superior to the high-anxiety group on the initial trial on a stylus maze. However, no differences were obtained in a mirror-tracing test. Experimenters interpreted the results as indicative of a deficiency in improvising ability in the high-anxiety group. They suggest this was brought about by a response set to reduce anxiety by adhering to familiar and stereotyped responses in a novel learning situation.

Marteniuk and Wenger (1970) examined the effects that stress, induced through the application of electric shock, had on the learning of a pursuit-rotor task. Two types of shock were used, one related and the other unrelated to the demands of the task. The purpose of this distinction was to study the factor of stress realism. Results showed that performance in the two stress conditions was not different for subjects in the experimental group than that of a control group. However, when tested twenty-four hours later, both stress groups demonstrated significant improvements in learning over the control group but no difference between each other.

Studying the effects of stress on skill learning, Willis (1967) found that stress affects transfer performance in three distinguishable ways: (1) through stimulus generalization, (2) through acquisition skill level, and (3) directly, i.e. independently of stimulus generalization and acquisition skill level.

Pearson and Thackery (1968) attempted to relate performance change under stress to individual differences in cognitive appraisal. The investigators found that high fear-of-shock subjects revealed significantly greater heart rate acceleration and performance impairment on a pursuit-rotor task than low fear-of-shock subjects. But this occurred only under the condition in which subjects were told that receipt of shock would be contingent on prior performance level. No relationship was found between fear-of-shock classification and scores on the MAS. The investigators suggested that under certain conditions the introduction of an apparently appropriate coping response may result in greater stress than a situation in which no control is possible.

Vaught and Newman (1966), investigated the relationship between extreme Manifest Anxiety Scores and performance in a simple motor steadiness test. In addition, the authors also attempted to determine the influence of "competition" on extreme MAS scores. The authors found that low-anxiety subjects made fewer errors than high-anxiety subjects in the steadiness test, and that the competition exaccerbated performance differences between high-anxious and low-anxious subjects.

Martin (1961), upon reviewing research on anxiety conducted during the fifties, noted the development of a number of scales to measure "manifest anxiety". In particular, he commented that the scales were used to predict performance on a variety of perceptual-motor and learning tasks, and that the results of such attempts have been equivocal. Wiggins, et al (1962) compared the effects of measured and judged anxiety on a perceptual motor steadiness task. The investigators found judged anxiety to be a better predicator of performance than measured anxiety. It was suggested that predictability of individual performance on the steadiness task based on manifest anxiety scores is somewhat questionable. Similarly, other investigators who have used stress on subjects measured by the manifest anxiety scale indicated that both levels of anxiety were affected in the same direction and to the same degree by stress (Davidson, Andrews, and Ross, 1956; Lazarus, Deese, and Hamilton, 1954; Lee, 1961; Taylor, 1953). In contrast however, Deese, Lazarus, and Keenan (1953) found that while the differences between high-anxious and low-anxious subjects increased under shock stress, this was due primarily to the disruptive effect of the shock on the low-anxious subjects.

Ryan (1961) designed a study to investigate grip strength performance in four experimental conditions: threat of electric shock, knowledge of results, constant exhortation, told to do as well as possible. Results showed no differences between the groups. Earlier, Ryan (1961) attempted to study motor performance under stress as a function of the amount of practice. He found that stress late in learning (electric shock), had a less disruptive effect than when introduced early in learning.

Later, Ryan (1962) conducted a study to test the hypothesis that externally induced tension will facilitate performance on a relatively easy motor skill, but impair performance on a more difficult motor skill, and to test the further hypothesis based on Hull's Drive Theory, that learning *per se* will not be influenced by tension. The task consisted of balancing on a stabilometer. Difficulty was increased by raising the height of the platform. Half of the subjects were administered electric shock during the learning period, to induce tension. The results supported the hypothesis that increased tension impairs performance of a difficult task and that rate of learning is independent of the state of tension for either difficult or easy skills.

Carron (1968), designed an experiment to study motor performance under stress -- performance on a stabilometer in the presence of an electric shock stressor. The researcher concluded that the early shock administration had a differential effect upon the improvements in performance of the high-anxious and the low-anxious subjects. Stress, introduced late resulted in a significant decrement in amount of performance improvement for both high-anxious and low-anxious subjects. Upon removal of the shock stressor, both high-anxious and low-anxious subjects significantly improved in performance, thereby achieving their prestress levels of performance.

Martens (1971) reviewed the literature concerned with the anxiety-motor behavior relationship using the state-trait anxiety distinction. The literature reviewed focused on the relationship between Taylor's MAS and motor behavior in the absence or in the presence of a stressor, and on those studies using anxiety scales other than the MAS. The accumulated evidence failed to reveal any consistent trends in these three areas. The use of drive theory and the MAS to predict motor behavior was shown not to be a viable approach. Two alternative approaches were briefly outlined. One was Easterbrook's (1959) cue utilization concept as related to the inverted-U hypothesis, and the other is Sarason, Davidson, Lighthall, Waite, and Ruebush's (1960) situational anxiety approach -- with respect to which, Martens cites Spielberger's STAI as possessing the most impressive credentials.

Further, Martens (1971) notes that much of this research investigated the relationship between anxiety and motor behavior which was formulated in terms of Hull-Spence drive theory. He notes that much of the conflicting findings of these studies are exemplary of not only the enigmatic general anxiety literature but of the literature specifically concerned with the relationship between MAS and motor behavior in the absence of stress. He also notes that one of the inherent problems of the theory is in determining the habit heirarchy of motor responses -- which changes as a function of practice. The obvious question then, as noted by the author, is can the habit heirarchy for a motor task be determined? The author notes that the evidence is far from satisfactory for reaching any definite conclusions from the data on hand -- no firm trends are apparent when task difficulty and hence, habit strength is varied. The author concludes that because of experimental evidence and the inability to accurately determine habit strength, that drive theory be abandoned and that other theoretical approaches be considered.

Carron (1971) in a reaction to Marten's (1971) paper, focused chiefly on state anxiety and motor performance. In his conclusion, Carron delineated three major limiting factors of concern in regard to the study of state anxiety and motor performance: (1) differences in subjects' responses to similar stressful conditions, (2) the quantification or objective measurement of state anxiety, and (3) the interaction of state anxiety with motor task difficulty. Also, Carron suggests that state anxiety not be thought of as something imposed on a subject but rather as the subjects' response to events in his external or internal environment. This view is shared by such researchers as Lazarus, Speisman, and Mordkoff (1952), who noted that level of state anxiety will depend on what the individual expects or demands of himself. Carron concludes with the further suggestion that, anxiety, like motor ability and intelligence, is comprised of a series of specifics. If this is so, then man would be, by definition, selective in his anxiety.

In this respect, Janet Taylor Spence (1971) admits that her theorizing, and that of Drive theory in particular, has not been without deficiencies, although a modest degree of success in studies of classical conditioning and verbal learning has been achieved. Spence notes that efforts concerning investigations of motor behavior and the MAS have been few. Spence also comments that no particular theory has been developed into which drive-anxiety concepts can be incorporated. On the topic of subject selection via the use of tests, Spence points out that specific measures such as the MAS do not yield advancements in understanding the relationship between anxiety and behavior. She suggests that for investigators whose primary focus of interest is on a particular type of setting or activity and whose concern is with subjects who are characteristically fearful, the most sensible kind of measure to use is the situationally-oriented test. One such test is the State-Trait Anxiety Inventory.

The State-Trait Anxiety Inventory (STAI) was developed to provide reliable, relatively brief, self-report measures of both A-State and A-Trait (Spielberger, et al. 1970). Martens (1971), in a critical paper about anxiety research and motor behavior supports the merits of the STAI, and notes that only through additional research using the STAI will its full potential be unveiled.

An attempt to determine the effects of success and failure in gross motor activities was instigated by Noyes (1971). The research reported that: (1) high A-Trait subjects responded with high A-State scores, (2) the stress condition which involved competition against bogus norms resulted in A-State increments for the high-anxious failure, and low-anxious failure, and low-anxious success groups, and (3) the high-anxious success group did not show A-State increments following their successful competition.

Newmark (1972) examined the validity of Spielberger's (1966) conceptualization of state and trait anxiety over a relatively prolonged period of time. Each subject was administered both the A-Trait and A-State forms of the STAI on four different occassions over a ten month period. The results supported Spielberger's (1966) theoretical conceptualization of anxiety phenomena that posits two anxiety constructs. Further, Spielberger, Gorsuch, and Lushene (1970) include evidence in their manual which lends support to the Trait-State theory.

In a statement regarding the future of research on anxiety and motor behavior, Spielberger (1971) indicates the importance of the development of appropriate motor tasks in which it is possible to assess the relative strength of correct and competing response tendencies.

In a paper on empirical findings and theoretical problems in the use of anxiety scales, Sarason (1960) noted that few areas of study in psychology have matched the output of research on anxiety. The purport of his paper was to identify trends which seemed of potential significance. The research reviewed in Sarason's paper suggests that several methodological problems remain to be solved in the assessment of the relationship between anxiety and stress. For example, on the experimenter side, there is the confounding of variables such as experimental instructions with characteristics of the experimenter administering such instructions. Essentially, the aim of Sarason's paper was to point out some of the consistencies and inconsistencies in anxiety research. The paper also seems to suggest some of the uncontrolled and confounding variables which warrant systematic consideration in future research.

Anxiety and physiological correlates. A group of experimental psychologists interested in problems of learning was responsible for the development of Taylor's Manifest Anxiety Scale (MAS) (Sarason, 1960). The main interest of these researchers in the MAS was in the measurement of Hull's Drive in human subjects who were being studied in learning situations. Because of the variety of human behavior and situations, investigators seized upon the easily administered MAS to inquire into relationships between anxiety measures and manifested behavior (Eichhorn and Tracktir, 1955; Fiedler, et al., 1958; Janis 1955; Nicholson, 1958).

Malmo (1957) recognized the potential merits of the MAS as a screening device for the selection of subjects. Deane (1961, 1964), concurred with Malmo in suggesting that physiological measurements could be applied to provide values that would place each subject on a continuum. However, some researchers have found that questionnaire defined anxiety such as MAS do not seem to relate consistently to physiological responding (Beam, 1955; Berry and Martin, 1957; Calvin, McGuigan, Tyrell, and Soyars, 1956; Martin, 1961; Sarason, 1960). Sarason (1960) has suggested that the reason for the lack of consistent relationships to physiological measures is due to individual differences among subjects in their physiological response patterns under stress conditions.

Hickham, Cargill, and Golden (1948) found heart rate and cardiac output to increase substantially in medical students prior to an anxiety arousing situation (a final examination). Likewise, Malmo (1957) reports increased heart rate in neurotic subjects after criticism as compared with decreased heart rate after praise. Although studies of this kind tend to corroborate with others (Ax, 1953, Barcroft and Konzett, 1949; DeLangy, Greenfield, McCorry, and Whalen, 1950; DiMascio, Boyd, and Greenblatt, 1957; Lewinsohn, 1956), Martin (1961) suggests that they do not answer the question of whether some pattern of response related to anxiety can be differentiated from patterns of response associated with other kinds of arousal states. Some of the available evidence tends to support the belief that different stimuli elicit distinctive autonomic response patterns (Chase, Graham, and Graham, 1968; Davis, Buchwald and Frankman, 1955; Davis and Buchwald, 1957; Lacey and Lacey, 1964; Obrist, 1963). In this respect Carron (1971), suggested the use of an objective physiological indicator for state anxiety which would provide some measure of the individual's state of anxiety compared to other individuals.

Mordkoff (1964) investigated the relationship between physiological and psychological response to stress, and the conditions under which the degree of relationship could be altered. He found a substantial relationship between psychological experience and the physiological measures of skin resistance, heart rate, and respiration. The various physiological variables demonstrated differential correspondence to the ratings of psychological impact.

Roessler, Burch, and Childers (1966) found GSR recordings to be consistent with increased stress conditions of sound and light intensities. Campos and Johnson (1966, 1967) investigated the effects of verbalization instructions and amount of visual attention on direction of change of heart rate and skin conductance. They found little evidence for directional fractionation of skin conductance and heart rate, as was reported by Davis and Buchwald (1957). In addition, verbalizing instructions produced a highly significant effect on heart rate and skin conductance. The investigators suggested that the requirement to verbalize can produce important changes in degree and direction of autonomic activation.

Two experiments were conducted by Andreassi and Whalen (1967) to investigate physiological activity, such as, heart rate, palmar skin conductance, and galvanic skin responses associated with original learning and over learning of verbal materials (nonsense syllables). The results showed decreases in all of the physiological measures with overlearning, and increases in all of the physiological measures with new learning. The researchers concluded that the drop in physiological activity which occurred with overlearning was due to an habituation of physiological responses when subjects were no longer required to assimilate novel materials and a reduction in apprehensiveness as the experiment progressed. This would appear to be in agreement with Eason, Harter, and Storm's (1964) suggestion that physiological activity decreases as subjects gain confidence in ability to learn lists of syllables.

Heart rate, skin conductance, integrated electromyogram, respiration rate and finger temperature measurements were recorded by Wilson and Wilson (1970). They attempted to test the hypothesis that muscle relaxation would reciprocally inhibit anxiety during a paired-associate learning task. Partial substantiation for the hypothesis was obtained for high-anxiety subjects, as determined by the IPAT anxiety inventory. Heart rate was the physiological variable which best discriminated the groups. Deane (1961, 1964) investigating heart rate response during experimentally induced anxiety, found heart rate to increase on anticipation of electric shock.

Using an eight-choice reaction task, Danev and De Winter (1971) studied the influence of erroneous responses upon the temporary changes in the level of heart rate. They found that after errors there was a short-term deceleration of the heart rate level, while after correct responses an acceleration tendency was found. This result can be considered as a contrast to the findings of Andreassi and Whalen (1967), cited above.

In an attempt to determine the effects of specific instructions in relaxation and neuromuscular tension control on changes in the performance of a memorization test under stress, Chaney and Andreasen (1972) recorded GSR, respiration rate, and EMG readings. Stress was induced by a verbal threat. The investigations concluded that those subjects who were taught to control neuromuscular tension performed significantly better on the final test than subjects who were not taught to control neuromuscular tensions. Differences in EMG recordings was signficant across the three groups tested. Similarly, Nakamura and Broen (1965a, 1965b) found that relaxed subjects tended to give more competing responses in a discrimination learning task.

Levinson and Fenz (1971), in accord with traditional notions about the autonomic reactions of a person in a stressful or arousing situation, investigated the relationship between motivation and cardiac activity. Their study was, in effect, concerned with anticipation in an attentional task. It was found that increases in motivation, while not affecting the overall pattern of the cardiac response, lend to increases in the amplitude of the response. Lacey (1959), studying four stimulus conditions labeled "visual attention", "emphatic listening", "thinking", and "withstanding pain", found definite directional fractionation of the physiological measures. Palmar skin conductance increased under all four conditions, while heart rate increased only under the conditions of "thinking", and "withstanding pain". In a similar investigation, Lacey, et al. (1962) found cardiac deceleration in those situations which required that the subjects note and detect incoming stimulation. Cardiac acceleration, on the other hand, was found in those situations in which the stimulation was unpleasant, or settings in which external distractions would interfere with internal cognitive events.

In an attempt to identify physiological correlative indices of a paper-and-pencil measure of test anxiety (MAS), Harleston, Smith and Arey (1965) recorded heart rates while subjects attempted to solve anagrams. The principal findings were that significantly larger increases in heart rate with the onset of the problem-solving task were found in high-anxious subjects than those who were classified as low-anxious. Also, large increases in heart rate were consistently associated with anagram problem solving. The investigators concluded that the physio-lgoical correlative index was sensitive to both anxiety level and the task situation. In a study of the psychometric and physiological indices of anxiety, Forrest and Kroth (1971) questioned whether psychometric scales measure chronic or reactive anxiety. In theory, the chronic hypothesis assumes that high-anxiety subjects manifest higher drive than do low-anxiety subjects in all situations (Farber and Spence, 1956; Taylor, 1956). On the other hand, the emotional reactivity hypothesis assumes that high-anxiety subjects react with higher drive than do low-anxiety subjects only in situations containing some degree of stress (Desiderato, 1964; Ominsky and Kimble, 1966).

Schnore (1959) demonstrated that an increase in task difficulty and task stress produced heightened physiological activity in a variety of indicators -- heart rate, blood pressure, respiration rate, and right forearm muscle tension were more sensitive to task and situational changes than other indicators.

Harleston et al. (1965), in their review of literature noted that efforts to relate physiological indicators to anxiety scale scores are few in number, and inconsistent in relationships. Rossi (1959) found that high-anxious subjects had significantly higher muscle-action potentials than low-anxious subjects prior to responding on a reaction-time task. Rossi interpreted the results as support for the view that the MAS measured chronic drive rather than susceptibility to drive. On the other hand, McGuigan, Calvin, and Richardson (1959) found no relationship between the MAS and palmar-sweat index in a maze learning situation.

In spite of some inconsistencies, Martin (1961) notes that there does appear to be evidence for distinguishable physiological response patterns that can be tentatively associated with the constructs of anxiety and anger. In his review of literature, Martin cites diastolic blood pressure, heart rate, and palmar conductance as tenable physiological indicators of the psychological constructs. Sarason (1960), however, cautions that the situational and experimental conditions under which an hypothesized relationship should be present or not present have not been explored.

Mordkoff (1964) investigated the possibility of a relationship existing between physiological and psychological response to stress. The physiological measures obtained included: skin resistance, heart rate, and respiration rate. The author found a substantial relationship between physiological response and psychological experience. Deane (1961, 1964) studied the effect on heart rate response of anxiety induced by threat of electric shock. The findings showed that all subjects experienced an acceleration in heart rate prior to receiving shock and deceleration immediately before the shock was administered. The investigator concluded that at the moment the noxious stimulus is expected, a state of fear with its associated response of cardiac deceleration is aroused. Further, studies by Jenks and Deane (1963), and Deane (1966), have provided evidence that there are two opposing heart rate responses during experimentally induced anxiety.

Spielberger (1971), in a reaction to a paper by Carron (1971), indicates he does not share Carron's view about the use of physiological measures in the assessment of anxiety. But he agrees that patterns or combinations of such measures should be more effective than single measures. However, Spielberger notes that the research findings with regard to the definition of emotional states, in terms of their physiological properties, are not very impressive. Consequently, he suggests that the use of both self-report and physiological measures of A-State be used whenever time and circumstances permit.

On the basis of Spielberger's trait-state concepts, Forrest and Kroth (1971) investigated the relationships between psychometric indices of anxiety (MAS and STAI) and vascular indices of arousal. The most interesting finding concerns the low trait and low MAS subjects whose physiological responses reflect a predisposition to respond to stress with heightened autonomic arousal. After introduction to the stressful task (continuous matching, upon which was superimposed a shock avoidance contingency), the low trait and low MAS subjects experienced diastolic blood pressure increases significantly higher than the moderate level trait subjects. This finding suggests that subjects exhibiting low levels of tested trait and manifest anxiety tend to avoid anxiety-evoking situations and therefore have not developed coping mechanisms to deal with stress. Therefore, when forced to confront these situations, they behave with considerable vascular arousal.

Saltz (1970) reported that the relationship between manifest anxiety and performance is dependent upon the stressor invoked in the experimental situation. He found that high-anxious subjects showed disrupted behavior under failure-induced stress, but not under pain-induced stress. Low-anxious subjects, on the other hand, were disrupted by pain-induced stress, but not by failure induced stress.

Support, then, for the emotional reactivity hypothesis was obtained in that differential responding occurred only during the stressful task, not during the baseline period. A similar finding is reported by Kaplan (1966) in a therapy-like situation and is suggestive of the need for further investigations.

Anxiety and test situations. Deese et al. (1953), explored the relationship between experimentally induced stress and personality factors, as determined by the MAS. They found that high-anxious subjects learned nonsense syllables better than low-anxious subjects, while performing in stress conditions.

Spielberger and Smith (1965) studied the effects of word-position and stress-nonstress experimental conditions on performance in serial-verbal learning for high and low-anxious subjects -- as determined by the MAS. Significant differences were found only in the stress condition in which the performance of high-anxious subjects was inferior to that of low-anxious subjects early in learning, and superior later in learning. It was concluded that the effects of anxiety on serial learning depend upon experimental stress, characteristics of stimulus materials, serial-position phenomena, and, on individual defferences in intelligence.

Gordon and Sarason (1955) attempted to study the extent to which anxiety in a testing situation is a part of a more generalized pattern of anxiety. They also sought to describe the generalized patterns in order to infer further differences among varying degrees of "test anxiety". The results showed: (1) significantly more subjects reporting experiencing anxiety in a testing situation also report experiencing anxiety in other situations, and (2) significant differences between high-anxious and low-anxious groups.

Sarason and Palola (1960) carried out three experiments to investigate the relationship of test and general anxiety, difficulty of task, and experimental instructions to performance. The tasks used were a digit symbol test and an arithmetic test. The results showed that test anxiety was related to task performance more frequently than to general anxiety when measured by Bendig's short form of the MAS. In general it appeared that high difficulty of task and highly motivating instructions combined to detrimentally affect the performance of high-anxious subjects. It was concluded that attempts at relating anxiety to either the instructional or difficulty variables alone would not be as fruitful as simultaneous analyses of the three variables.

Bucky, Spielberger, and Bale (1972) studied the effects of instructions on measures of state and trait anxiety. The STAI was administered twice, one with standard instructions and then under an artificially induced anxiety situation. The authors found that, with the induced anxiety act, both state and trait anxiety scores were significantly lower than the scores obtained during the initial test administration.

Allen (1970) investigated the effect of three conditions of administration on "trait" and "state" measures of anxiety; measures of academic performance were also obtained. The hypothesis that specific demand characteristics would differentially influence subjects' scoring on trait and state anxiety scales was supported. But no support for a hypothesized relationship between the operation of demand characteristics and systematic changes in the correlatives between the anxiety scales and academic performance was found.

Morris (1971) investigated the state anxiety reactions of subjects differing in level of trait anxiety to two kinds of threat: (1) threat of failure, and (2) threat of electric shock. Subjects were tested on a Digits Backward memory task. The investigator hypothesized that high and low A-Trait subjects would differ in A-State scores in the failure-threat conditions only. This belief was not supported; however, the results showed that A-State scores were higher for high A-Trait subjects than for low A-Trait subjects.

McAdoo (1971) investigated the effects of success and failure feedback on state anxiety (A-State) for subjects who differed in trait anxiety (A-Trait). Two levels of psychological stress were induced by giving subjects negative feedback about their performance on a memory task.

McAdoo found that the A-State scores and skin conductance levels of both high-anxious and low-anxious subjects increased significantly from rest to performance. The effects of feedback were a function of subjects' trait anxiety; success feedback lowered A-State scores for high-anxious and low-anxious subjects. Finally it was found that in situations involving ego-threat (failure), high-anxious subjects displayed greater increases in A-State than low-anxious subjects.

Houston, et al. (1972) investigated Lazarus's (1966) proposition that chronic or dispositional anxiety is based on the anxious person's beliefs that the environment is generally dangerous or threatening. The results indicated that beliefs that the environment is generally dangerous and threatening to self-esteem are significantly related to dispositional anxiety. Findings also suggested that chronically anxious people generally expect bad events to occur in situations involving threat to physical well-being and in situations involving potential threat to self-esteem. The authors concluded that while trait anxiety may not be related to fear of physical injury, as Hodges and Spielberger (1966) assert, trait anxiety is related to the generalized expectation that bad events will occur in situations involving potential physical injury.

Anxiety and studies of women. Some of the selected research concerned with anxiety in women, using the MAS, have found that females tend to score higher than males (Bendig, 1954; Goodstein and Goldberger, 1955; Jahnke, Cromell, and Moussette, 1964; Lazowick, 1955; Sinick, 1956; Taylor, 1953). Goodstein and Goldberger (1955) attributed the higher female MAS scores to a basic difference in anxiety level. However, Jahnke, et al. (1964) and Moffitt and Stagner (1956), have suggested that the higher female MAS scores can be attributed to the female cultural stereotype. Quarter and Laxer (1969) conducted a study in which they compared the performance of males and females on the MAS. The results showed the females scoring significantly higher than the males. On inspection of the MAS, the authors concluded that investigations selecting subjects on the basis of MAS scores should either: (1) restrict the study to either all males or all females, (2) include the same ratio of males to females in each group of the experiment, or (3) insure that no sex differences in scoring exist in the population under study. Thus, the importance of exercising caution in interpreting results from the MAS is emphasized, particularly where heterogeneous groups are used.

In a study of anxiety and anger in adolescent girls, Kaczkowski and Owen (1972) tested McCall's (1963) proposal which characterizes anxiety as a general fear of disapproval. The subjects were required to write a description of the last time they felt anxiety and the last time they felt angry. Procedures were followed in the research to familiarize subjects with the wide range of usage of terms. The investigators found that anxiety and anger developed in specific situations -- as recorded by the subjects. The investigators concluded that McCall's proposal that anxiety, fear of disapproval by others, anger, and our disapproval of others for violating personal expectations, appears to have some validity.

Current evidence seems to provide support for the validity of the STAI in terms of sex considerations (Spielberger, Gorsuch, and Lushene, 1970). Correlations with the IPAT Anxiety Scale (Cattell and Scheier, 1963) the Taylor (1953) MAS, and the Zuckerman (1960) AACL, are reported. A-State scale scores are shown to be approximately the same for males and females, indicating that these conditions had similiar impact on both sexes. Newmark (1972) varified this finding with his study of the stability of state and trait anxiety. He found virtually no difference between the sexes, and his results showed a high correlation between both STAI subscales.

Earlier, however, Lushene (1970) investigated changes in the STAI and in self-report measures of the autonomic, ideational, and motoric components of A-State. On the basis of the results he suggested that the type of stress, whether physical or psychological, and the sex of the subject, are important variables which should be given more consideration in anxiety research.

Many of the anxiety studies investigating the performance of female subjects on motor skills have virtually adhered to the drive theory concept, or some version of it (Burton, 1971; Griffin, 1972; Karbe, 1966; Lockhart, 1968; Ryan, 1962). The most popular theory at present seems to be Spielberger's (1966) Trait-State Anxiety Theory (Martens, 1971). However, as Martens notes, only through additional research using this theory will its real merits be disclosed.

Summary. In general, it has been shown that investigations applying drive theory to motor behavior are considerable in number. From the literature reviewed, it is quite clear that future research, based on the drive theory concept, will require careful evaluation of the response tendencies that are evoked by motor tasks. Caution will have to be taken to guard for the effects of practice on the relative strengths of correct responses and competing error tendencies. Further, as Marteniuk (1971) has suggested, the effects of massed and distributed practice, and level of arousal must be taken into account.

In that the study of human behavior is the search for parsimonious explanations of behavior, Martens (1971), in a review of anxiety and motor behavior, suggests the situational anxiety approach. He also criticizes the trait anxiety approach for not providing information on the antecedents, nature, and consequences of this conception in varied environmental settings.

Spielberger (1966) was sensitive to the inconsistent and contradictory findings reported in investigations about anxiety and motor behavior. He was aware that many of these investigations failed to make the conceptual distinction between state and trait anxiety, and that inappropriate operational measures of A-State and A-Trait had been used. Consequently, on the basis of Spence's (1958) Reactive Hypothesis, Spielberger (1966) conceived of the Trait-State Theory of Anxiety, and later developed the STAI (Spielberger, et al., 1970) to provide reliable, relatively brief, self-report measures of both A-State and A-Trait.

A critical evaluation of the research literature suggests that high A-Trait subjects tend to show performance changes attributable to higher drive in situations characterized by psychological stress, but not in situations involving physical danger (Spence and Spence, 1966; Spielberger, 1966, 1971). Thus, in order for an experimental situation to evoke differential levels of A-State in subjects who differ in A-Trait, some type of psychological stress appears to be required.

Therefore, on this premise, and because of the paucity of research concerned with anxiety and women, the investigator was motivated to conduct the study herein reported.

CHAPTER III

PROCEDURES

Subsequent to the survey of related information and specification of the problem, the following procedures were carried out in the conduct of this research.

Identification and Labeling of Variables

Specification of variables was an early step in planning the design of this study. The independent variables were defined as: (1) anxious-induced condition -- by the threat of electric shock being administered while subjects performed on the mirror-tracing task, and (2) non-anxious condition -- performing on the mirror-tracing task in the absence of the threat.

Subjects' performance on the mirror-tracing task as quantified by the following formula was designated as the dependent variable (Lockhart and Johnson, 1970).

$$\frac{100}{\text{time to complete task} + \text{number of errors}} = \text{performance score}$$

Subjects' A-Trait and A-State levels as determined by the STAI, and their changes in heart rate between resting and performance states, as interpreted from electrocardiogram (EKG) tracings were designated as moderator variables (Tuckman, 1972).

Selection of Subjects and Assignment to Group

The subjects were female undergraduate students participating in activity service classes sponsored by the School of Health, Physical Education and Recreation at the University of North Carolina at Greensboro during the spring semester, 1973. All subjects were recruited on a volunteer basis, and asked to complete an address questionnaire. These subjects were later contacted at their place of residence by the investigator.

At a specially arranged meeting with the investigator, subjects were asked to respond to the A-Trait questionnaire. Following the completion of the questionnaire (A-Trait), subjects made an appointment, for Rosenthal Laboratory, to perform the task. This took place on a subsequent day. Meanwhile, the experimenter tabulated the A-Trait scores.

On the basis of their A-Trait scores, subjects were designated as being either high-anxious, moderate, or low-anxious. Criterion scores for defining anxiety categories were selected in the following manner. Scores of 40 and below, as low-anxious, and scores of 51 and above as high-anxious (see letter 1, Appendix C). Subjects whose scores fell within the moderately anxious range (between 40 and 51), were excluded from further participation in the study. Next, the high-anxious and low-anxious subjects were systematically assigned to participate in either the anxious-induced condition, or the non-anxious condition. Consequently, from the 122 subjects who responded to the STAI, 46 were classified as being high-anxious -- 23 of these subjects were assigned to the anxious-induced condition, and the remaining 23 subjects were assigned to the non-anxious condition; 41 subjects were found to be low-anxious.

Of these, 21 were assigned to the anxious-induced condition, and the remaining 20 subjects were assigned to the non-anxious condition. Thus, a total of 87 subjects participated in the actual experiment.

Manipulations and Controls

Task conditions. To preserve the novelty of the task and to ascertain subjects' naivete in this regard, each subject was questioned as to having had any previous experience on the mirror-tracing task. Any individual indicating some experience with the mirror-tracing apparatus was subsequently relieved of her obligation to the experiment.

The anxious-induced condition was elicited by the concurrent incidents of: (1) experimenter's verbal instruction, "...if your performance is unsatisfactory, you will hear the first sound of the warning bell. If your performance remains to be unsatisfactory, you will hear the second warning bell. However, if after the second warning bell your performance remains unsatisfactory, you will receive an electric shock," and (2) the attaching of electrodes to the forefinger and forearm of the non-preferred arm of the subjects. In effect, no electric shock was administered to subjects. However, the threat of the noxious stimulus served to invoke an anxious situation. The non-anxious condition was created by eliminating the psychological stressor threat of electric shock while subjects executed one tracing of the task.

Testing environment. The School of Health, Physical Education and Recreation at the University of North Carolina at Greensboro granted the experimenter the use of the Rosenthal Laboratory and the necessary equipment to carry out the investigation.

During the testing, only the following three people were present in the laboratory: the experimenter, one subject, and one assistant -- a female graduate student.

All subjects performed the mirror-tracing task while seated at a table, with both the experimenter and the assistant situated behind the subject, monitoring the heart rate recordings.

Instrumentation. The following tools of research were used in this study: (1) The STAI -- alpha coefficients for the A-Trait and A-State scales were computed by formula K-R 20 for normative samples. These reliability coefficients which ranged from .83 to .92 for A-State, and from .86 to .92 for A-Trait, indicate a reasonably good consistency for both subscales. Further evidence reporting the reliability and validity of the STAI are found in the STAI Manual (Spielberger, Gorsuch, and Lushene, 1970). The experimenter received written permission from Dr. C.D. Spielberger for the use of the STAI in this study (see letter 2, Appendix C). Both STAI scales are shown in Appendix D. (2) The Physiograph Four was used for recording the EKG tracings. The portable, biotelemetry receiver and transmitter were used for relaying the subjects' cardiac impulses to the Physiograph Four (E and M Instrument Company, Houston, Texas). A standard conducting gel was used to facilitate cardiac impulse conduction between the skin surface and the EKG electrodes (3M Company). Sample tracing is replicated in Figure 1. (3) The equipment used for the mirror-tracing task consisted of a 6-pointed star, outlined on a 12" x 12" x 1/8" thick metal plate. Connected to the mirror-tracing task, via electrical circuitry, was an electric counter (Lafayette Instrument Company, Chicago, Illinois). Figure 2 presents a sketch of the equipment.

FIGURE 1

EKG TRACING

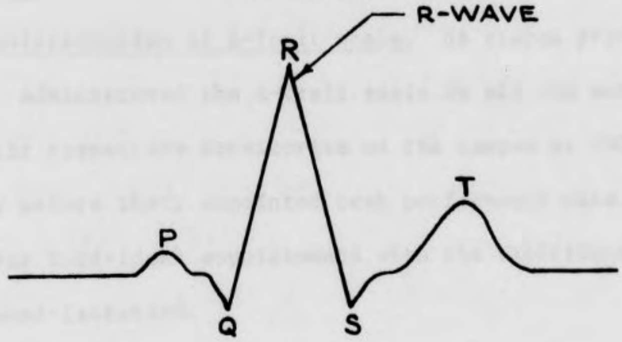
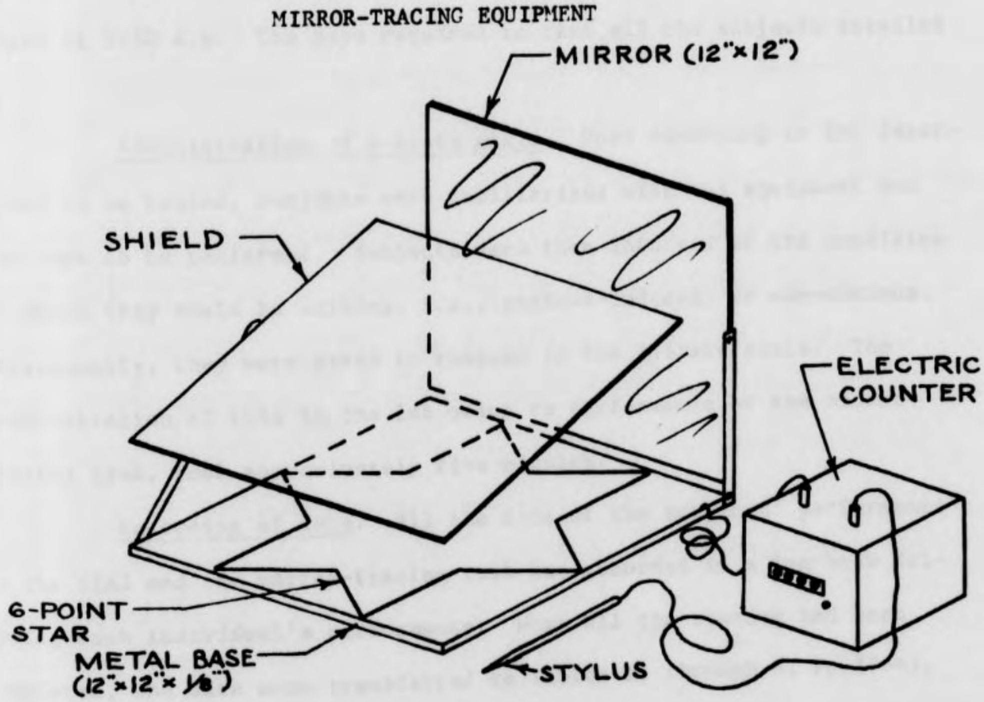


FIGURE 2

MIRROR-TRACING EQUIPMENT



Data Gathering

Administration of A-Trait scale. As stated previously the experimenter administered the A-Trait scale to all the subjects individually at their respective dormitories on the campus at UNC-G, at least one full day before their appointed task performance date. Subjects arranged their individual appointments with the experimenter at the time of A-Trait administration.

Scheduling of subjects to laboratory. Not more than 12 subjects per day reported to the laboratory to participate in the data gathering. Thirty minutes was established as ample time per person, per appointment. Testing continued from Monday through Saturday during the spring semester, specifically during the months of February and March 1973. No appointments were honored before 4:00 p.m. Saturday was an exception, testing began at 9:30 a.m. The days required to test all the subjects totalled 19.

Administration of A-State scale. Upon reporting to the laboratory to be tested, subjects were familiarized with the equipment and the task to be performed. Subjects were then informed of the condition in which they would be working, i.e., anxious-induced, or non-anxious. Subsequently, they were asked to respond to the A-State scale. The administration of this in the lab prior to performance of the mirror-tracing task, took approximately five minutes.

Recording of data. All the data of the subjects' performance on the STAI and the mirror-tracing task was recorded in a log book following each individual's performance. When all the testing had been completed, the data were transferred to Tables 1, through 6, Pp.57-62, and Tables 7, through 12, Pp.64-70.

Administration of independent variables. Each subject entering the laboratory on her appointed test day was, first, familiarized with the instruments. Next, EKG leads were attached to the sternum of the subject by the assistant -- using dual-sided adhesive discs. Then the subject was asked to sit comfortably in a designated chair and to relax, at which time a baseline resting heart rate was recorded. Following that, the subject was informed of the task condition that she would perform under and was subsequently administered the A-State scale. After a brief familiarization session on the mirror-tracing task, the subject was given the cue to start (Ready, begin).

During the subjects' performance, the experimenter and his assistant recorded the following measurements: heart rate, number of errors -- recorded by an electric counter, and time to complete the task. Thereafter, results were tabulated.

Physiological assessments -- heart rates were recorded by the EKG biotelemetry method. Two chrome plated electrodes were fastened to the subjects' sternum, vertically adjacent to one another. Tracings were recorded by the Physiograph Four stylus. Paper speed was set at a constant speed of 1.5 mm. per second, and the automatic timer marked the paper at 1.0 second intervals. Heart rate was measured by counting the number of vertical spikes (R-waves) traced in a 1 minute period -- approximately midway through the execution of the task (See Figure 1).

After subjects completed the task, the experimenter briefly outlined the purpose of his study to each subject and thanked each one for her contribution.

Administration of dependent variables. The mirror-tracing task (Lafayette Instrument Company, Chicago, Illinois) consists of a 6-pointed star outlined, with 1/4 inch wide non-conductive material, on a 12" x 12" x 1/8" thick metal base. A 12" x 12" mirror is mounted vertically, on an adjustable aperture, at one end of the base. Subject is required to trace the star with a stylus, which is attached by electrical circuitry to the metal base, and an electric counter. Vision of the star is obstructed by a shield mounted directly above it, approximately 8". Thus the subject is required to trace the star by viewing its image in the mirror. Every time the stylus is moved off the star's outline and comes in contact with the base, an error is recorded on the counter.

Following Drowatzky's (1969) and Lockhart and Johnson's (1970) recommendations for evaluating mirror-tracing performance, the previously cited formula was used to represent a subject's task performance.

Analysis of Data

Performance. The Mann-Whitney U-test, a non parameter test for significant differences was used to compare the performance between the high-anxious and low-anxious subjects tested in the two task conditions. The critical value of "U" was set at the .05 level of significance. A Monroe 990 Electronic Calculator was used to perform all calculations. See Appendix B for formulas and source citations.

Correlations. The Spearman rank order correlation coefficient was used to determine the relationship of A-State scores to (1) heart rate changes, and (2) task performance. Rho was calculated in accord with the formula indicated in Appendix B.

The above, then, accounts for the systematic way in which the procedures followed in this study were carried out.

CHAPTER IV

DATA AND ANALYSIS

Following tabulation of all data, they were examined as indicated in the previous chapter for significance of differences in performance of the mirror-tracing task, between high and low-anxious groups in both conditions. The results of this analysis and also treatment of data respresenting physiological parameters are presented in this chapter. All raw data are tabled in Appendix A.

Differences in Performance

The Mann-Whitney U-test was used to determine if the differences in the performances on the mirror-tracing task between the groups tested was significant. The critical value of U was set at an alpha (α) level of .05 for a one-tailed test. Appendix B illustrates the mechanics of this statistic. Further, calculations for the U values are presented in Tables 1, through 6.

TABLE 1

PERFORMANCE OF MIRROR-TRACING TASK UNDER NON-ANXIOUS CONDITION

Low-Anxiety Group			High-Anxiety Group		
Subject	Performance Score	Rank 1	Subject	Performance Score	Rank 2
72	2.13	1	42	1.96	2
71	1.92	4	40	1.93	3
75	1.75	5.5	39	1.69	7
83	1.75	5.5	30	1.07	12
86	1.56	8	33	1.05	13
74	1.37	9	29	1.04	14
80	1.19	10	43	.86	16
70	1.14	11	24	.83	17
76	1.00	15	38	.80	18
69	.78	19	25	.76	20
73	.71	25	28	.75	21.5
81	.66	26	32	.75	21.5
87	.64	27	45	.73	23
85	.61	28	34	.72	24
82	.55	29	41	.51	30
68	.50	31	31	.48	32
77	.38	33	37	.33	34
84	.31	35	26	.26	37
79	.28	36	27	.23	38.5
78	.18	41	44	.23	38.5
			36	.20	40
			46	.14	42
			35	.11	43
		394.0			547.0

n=20 n=23

alpha .05 = 152

$$U_{LA} = 23(20) + \frac{23(24)}{2} - 394.0 = \underline{189} > 152 \ @ \alpha = .05$$

$$U_{HA} = 23(20) + \frac{20(21)}{2} - 547.0 = \underline{276} > 152 \ @ \alpha = .05$$

TABLE 2

PERFORMANCE OF MIRROR-TRACING TASK UNDER ANXIOUS-INDUCED CONDITION

Low-Anxiety Group			High-Anxiety Group		
Subject	Performance Score	Rank 1	Subject	Performance Score	Rank 2
61	.87	1	16	.61	5
66	.73	2	6	.52	7
53	.69	3	7	.49	8
47	.62	4	11	.46	10
59	.60	6	8	.44	11.5
48	.48	9	19	.44	11.5
58	.41	18.5	2	.43	14
63	.41	18.5	17	.43	14
50	.37	23.5	23	.43	14
67	.37	23.5	9	.42	16.5
62	.36	25.5	12	.42	16.5
65	.36	25.5	21	.40	20
49	.35	27	13	.38	21.5
55	.33	30	18	.38	21.5
56	.30	35.5	10	.34	28.5
57	.30	35.5	14	.34	28.5
52	.29	37	4	.32	31.5
51	.27	40.5	22	.32	31.5
60	.27	40.5	15	.31	33.5
54	.24	43	20	.31	33.5
64	.23	44	1	.28	38.5
			5	.28	38.5
			3	.25	42
		493.0			497.0
n=21			n=23		

alpha .05 = 158

$$U_{LA} = 21(23) + \frac{21(22)}{2} - 493.0 = \underline{221} > 158 \ @\alpha = .05$$

$$U_{HA} = 21(23) + \frac{23(24)}{2} - 497.0 = \underline{262} > 158 \ @\alpha = .05$$

TABLE 3

PERFORMANCE OF MIRROR-TRACING TASK

BY LOW-ANXIETY GROUPS

Non-Anxious Condition			Anxious-Induced Condition		
Subject	Performance Score	Rank 1	Subject	Performance Score	Rank 2
72	2.13	1	61	.87	10
71	1.92	2	66	.73	12
75	1.75	3	53	.69	14
83	1.75	4	47	.62	17
86	1.56	5	59	.60	19
74	1.37	6	48	.48	22
80	1.19	7	58	.41	23
70	1.14	8	63	.41	24
76	1.00	9	50	.37	26.5
69	.78	11	67	.37	26.5
73	.71	13	62	.36	28.5
81	.66	15	65	.36	28.5
87	.64	16	49	.35	30
85	.61	18	55	.33	31
82	.55	20	56	.30	33.5
68	.50	21	57	.30	33.5
77	.38	25	52	.29	35
84	.31	32	51	.27	37.5
79	.28	36	60	.27	37.5
78	.18	41	54	.24	39
			64	.23	40
		324.0			567.0
	n=20			n=21	

alpha .05 = 146

$$U_{NA} = 20(21) + \frac{20(21)}{2} - 324.0 = \underline{306} > 146 \ @\alpha = .05$$

$$U_{AI} = 20(21) + \frac{21(22)}{2} - 567.0 = \underline{84} < 146 \ @\alpha = .05,$$

and therefore is found to be significant.

TABLE 4

PERFORMANCE OF MIRROR-TRACING TASK

BY HIGH-ANXIETY GROUPS

Non-Anxious Condition			Anxious-Induced Condition		
Subject	Performance Score	Rank 1	Subject	Performance Score	Rank 2
42	1.96	1	16	.61	15
40	1.92	2	6	.52	16
39	1.69	3	7	.49	18
30	1.07	4	11	.46	20
33	1.05	5	8	.44	21.5
29	1.04	6	19	.44	21.5
43	.86	7	2	.43	24
24	.83	8	17	.43	24
38	.80	9	23	.43	24
25	.76	10	9	.42	26.5
28	.75	11.5	12	.42	26.5
32	.75	11.5	21	.40	28
45	.73	13	13	.38	29
34	.72	14	18	.38	30
41	.51	17	10	.34	31
31	.48	19	14	.34	32
37	.33	33	4	.32	34.5
26	.26	40	22	.32	34.5
27	.23	42.5	15	.31	36.5
44	.23	42.5	20	.31	36.5
36	.20	44	1	.28	38
46	.14	45	5	.28	39
35	.11	46	3	.25	41
		435.0			647.0

n=23 n=23

alpha .05 = 162

$$U_{NA} = 23(23) + \frac{23(24)}{2} - 435.0 = \underline{370} > 162 \text{ @ } \alpha = .05$$

$$U_{AI} = 23(23) + \frac{23(24)}{2} - 647.0 = \underline{158} < 162 \text{ @ } \alpha = .05,$$

and therefore is found to be significant.

TABLE 5

PERFORMANCE OF MIRROR-TRACING TASK

BY HIGH AND LOW-ANXIETY GROUPS

High-Anxiety Group Non-Anxious Condition			Low-Anxiety Group Anxious-Induced Condition		
Subject	Performance Score	Rank 1	Subject	Performance Score	Rank 2
42	1.96	1	61	.87	7
40	1.92	2	66	.73	14
39	1.69	3	53	.69	17
30	1.07	4	47	.62	18
33	1.05	5	59	.60	19
29	1.04	6	48	.49	21
43	.86	8	58	.41	23
24	.83	9	63	.41	24
38	.80	10	50	.37	25.5
25	.76	11	67	.37	25.5
28	.75	12.5	62	.36	27.5
32	.75	12.5	65	.36	27.5
45	.72	15.5	49	.35	29
34	.72	15.5	55	.32	31
41	.51	20	56	.30	32.5
31	.48	22	57	.30	32.5
37	.33	30	52	.29	34
26	.26	37	51	.27	35.5
27	.23	39.5	60	.27	35.5
44	.23	39.5	54	.24	38
36	.20	42	64	.22	41
46	.14	43			
35	.11	44			
		432.0			557.0
	n=23			n=21	

alpha .05 = 158

$$U_{HA} = 23(21) + \frac{23(24)}{2} - 432.0 = \underline{327} > 158 \ @\alpha = .05$$

$$U_{LA} = 23(21) + \frac{21(22)}{2} - 557.0 = \underline{257} > 158 \ @\alpha = .05$$

TABLE 6

PERFORMANCE OF MIRROR-TRACING TASK

BY HIGH AND LOW-ANXIETY GROUPS

High-Anxiety Group Anxious-Induced Condition			Low-Anxiety Group Non-Anxious Condition		
Subject	Performance Score	Rank 1	Subject	Performance Score	Rank 2
16	.60	15	72	2.13	1
6	.52	17	71	1.92	2
7	.49	19	75	1.75	3.5
11	.46	20	83	1.75	3.5
8	.44	21.5	86	1.56	5
19	.44	21.5	74	1.37	6
2	.43	24	80	1.19	7
17	.43	24	70	1.14	8
23	.43	24	76	1.00	9
9	.42	26.5	69	.78	10
12	.42	26.5	73	.71	11
21	.40	28	81	.66	12
13	.39	29	87	.64	13
18	.37	31	85	.61	14
10	.34	32	82	.55	16
14	.34	33	68	.50	18
4	.32	34.5	77	.38	30
22	.32	34.5	84	.30	38
15	.31	36.5	79	.28	40
20	.31	36.5	78	.18	43
1	.29	39			
5	.28	41			
3	.25	42			
		656.0			290.0

n=23 n=20

alpha .05 = 152

$$U_{HA} = 23(20) + \frac{23(24)}{2} - 656.0 = \underline{80} < 152 \ @\alpha = .05,$$

and therefore is found to be significant.

$$U_{LA} = 23(20) + \frac{20(21)}{2} - 290.0 = \underline{380} > 152 \ @\alpha = .05$$

As shown in the tables, the differences in performance between the high-anxiety (HA) group which worked in the anxious-induced condition, and the low-anxiety (LA) group which worked in a non-anxious condition was found to be significant (Mann-Whitney $U=80$, $n=23$, $n=20$, $p<.05$). Differences were also found within the HA and LA groups. HA subjects performing in the non-anxious condition scored higher on the task than the HA subjects who performed in the anxious-induced condition ($U=158$, $n=23$, $n=23$, $p<.05$). The LA subjects who performed in the non-anxious condition, scored higher on the task than the LA subjects who performed in the anxious-induced condition ($U=84$, $n=20$, $n=21$, $p<.05$). Further analysis did not yield any differences in performance between HA and LA subjects working in the non-anxious condition.

Relationship of Physiological Parameters

The Spearman (rho) rank-order correlation coefficient was used to inquire if relationships existed between subjects' A-State scores and: (1) heart rate changes, and (2) performance scores in both the non-anxious, and anxious-induced conditions. The critical value for r was set at alpha=.05 for a two-tailed test. Appendix B shows the procedure for calculating this statistic. The calculations for the rho values are presented in Tables 7 through 12. The correlations which were found are illustrated in Tables 7 through 12 also.

TABLE 7

CORRELATION OF A-STATE AND HEART RATE CHANGE FOR HIGH-ANXIETY SUBJECTS WORKING UNDER NON-ANXIOUS CONDITION

Subject	A-State	Rank	Heart Rate Change	Rank	D	D^2
31	39	1	12	9.5	8.5	72.25
41	41	2.5	22	21.5	9.5	90.25
39	41	2.5	12	9.5	7.0	49.00
33	42	4	6	2.5	1.5	2.25
44	43	5	16	15.5	10.5	110.25
34	45	6	6	2.5	3.5	12.25
42	46	7.5	4	1	6.5	42.25
43	46	7.5	10	7	.5	.25
28	47	9.5	22	21.5	12.0	144.00
30	47	9.5	8	4.5	5.0	25.00
27	48	12.5	14	13	.5	.25
37	48	12.5	18	17.5	5.0	25.00
45	48	12.5	14	13	.5	.25
46	48	12.5	30	23	10.5	110.25
25	49	16.5	20	19	2.5	6.25
26	49	16.5	9	6	10.5	110.25
38	49	16.5	12	9.5	7.0	49.00
41	49	16.5	14	13	3.5	12.25
32	50	19.5	16	15.5	4.0	16.00
36	50	19.5	18	17.5	2.0	4.00
40	51	21	21	20	1.0	1.00
29	52	22	8	4.5	17.5	306.25
24	53	23	12	9.5	13.5	182.25
						1370.75

n=23

$$r = 1 - \frac{6(1370.75)}{23(528)} = \underline{.324}$$

alpha .05 =.418

TABLE 8

CORRELATION OF A-STATE AND HEART RATE CHANGE FOR
LOW-ANXIETY SUBJECTS WORKING UNDER NON-ANXIOUS CONDITION

Subject	A-State	Rank	Heart Rate Change	Rank	D	D^2
71	33	1	24	17.5	16.5	272.5
84	36	2	8	2.5	.5	.25
80	37	3	24	17.5	14.5	210.25
68	40	5.5	14	8	2.5	6.25
75	40	5.5	18	15	9.5	90.25
76	40	5.5	15	10	4.5	20.25
85	40	5.5	8	2.5	3.0	9.00
69	41	8.5	26	19	10.5	110.25
72	41	8.5	0	1	7.5	56.25
74	42	10	14	8	2.0	4.00
70	44	11.5	16	12	.5	.25
86	44	11.5	12	5.5	6.0	36.00
82	45	13.5	38	20	6.5	42.25
83	45	13.5	18	15	1.5	2.25
77	46	16	12	5.5	.5	.25
79	46	16	14	8	8.0	64.00
87	46	16	18	15	1.0	1.00
78	49	18	10	4	14.0	196.00
81	51	19	16	12	7.0	49.00
73	53	20	16	12	8.0	64.00
						1507.00

n=20

$$r = 1 - \frac{6(1507.00)}{20(399)} = \underline{-.133} \qquad \text{alpha } .05 = .450$$

TABLE 9

CORRELATION OF A-STATE AND HEART RATE CHANGE FOR HIGH-ANXIETY SUBJECTS WORKING UNDER ANXIOUS-INDUCED CONDITION

Subject	A-State	Rank	Heart Rate Change	Rank	D	D^2
16	41	1	6	12.5	11.5	132.25
2	43	2.5	0	3	.5	.25
18	43	2.5	2	4	1.5	2.25
11	44	4.5	16	21.5	17.0	289.00
15	44	4.5	8	15.5	9.0	81.00
6	45	7	6	12.5	5.5	30.25
14	45	7	12	18	11.0	122.00
19	45	7	12	18	11.0	122.00
1	46	10.5	18	23	12.5	156.25
3	46	10.5	4	7.5	3.0	9.00
10	46	10.5	-6	1	9.5	90.25
21	46	10.5	4	7.5	3.0	9.00
8	47	13.5	8	15.5	2.0	4.00
17	47	13.5	6	12.5	1.0	1.00
4	48	16.5	12	18	1.5	2.25
7	48	16.5	4	7.5	9.0	81.00
20	48	16.5	14	20	3.5	12.25
23	48	16.5	4	7.5	9.0	81.00
9	49	20	4	7.5	12.5	156.25
12	49	20	-2	2	18.0	324.00
22	49	20	16	21.5	1.5	2.25
13	50	22	6	12.5	.5	.25
5	53	23	4	7.5	15.5	240.25
						1948.00

n=23

$$r = 1 - \frac{6(1948.00)}{23(528)} = \underline{.038} \qquad \text{alpha } .05 = .418$$

TABLE 10

CORRELATION OF A-STATE AND HEART RATE CHANGE FOR LOW-ANXIETY SUBJECTS WORKING UNDER ANXIOUS-INDUCED CONDITION

Subject	A-State	Rank	Heart Rate Change	Rank	D	D^2
52	37	1	12	5	4.0	16.00
56	38	2.5	18	17	14.5	210.25
60	38	2.5	16	13	11.5	132.25
59	39	5	14	8.5	3.5	12.25
64	39	5	30	20	15.0	225.00
67	39	5	28	19	14.0	196.00
49	40	7.5	10	3	4.5	20.25
57	40	7.5	16	13	5.5	30.25
53	41	9.5	16	13	3.5	12.25
63	41	9.5	14	8.5	1.0	1.00
47	42	11	14	8.5	2.5	6.25
54	43	12.5	36	21	8.5	72.25
62	43	12.5	18	17	4.5	20.25
51	44	14.5	14	8.5	6.0	36.00
65	44	14.5	18	17	2.5	6.25
48	45	16.5	16	13	3.5	12.25
61	45	16.5	12	5	11.5	132.25
58	46	18	4	1	17.0	289.00
66	47	19	12	5	14.0	196.00
50	48	20.5	16	13	7.5	56.25
55	48	20.5	6	2	18.5	340.25
						2022.50

n=21

$$r = 1 - \frac{6(2022.50)}{21(440)} = \underline{-.313} \qquad \text{alpha } .05 = .439$$

TABLE 11

CORRELATION OF A-STATE AND PERFORMANCE

FOR SUBJECTS WORKING UNDER NON-ANXIOUS CONDITION

Low and High-Anxiety Groups			Performance			
Subject	A-State	Rank 1	Score	Rank 2	D	D^2
71	33	1	1.92	3.5	2.5	6.25
84	36	2	.31	35	33.0	1089.00
80	37	3	1.19	10	7.0	49.00
31	39	4	.48	32	28.0	784.00
68	40	6.5	.50	31	24.5	600.25
75	40	6.5	1.75	5.5	1.0	1.00
76	40	6.5	1.00	15	8.5	72.25
85	40	6.5	.61	28	21.5	462.25
76	41	10.5	1.69	7	3.5	12.25
85	41	10.5	.11	43	32.5	1056.25
35	41	10.5	2.13	1	9.5	90.25
39	41	10.5	.78	19	8.5	72.25
74	42	13.5	1.37	9	4.5	20.25
33	42	13.5	1.05	13	.5	.25
44	43	15	.23	39	14.0	196.00
70	44	16.5	1.14	11	5.5	30.25
86	44	16.5	1.56	8	8.5	72.25
82	45	19	.72	24	5.0	25.00
83	45	19	1.75	5.5	14.5	210.25
34	45	19	.55	29	10.0	100.00
77	46	23	.37	33	10.0	100.00
79	46	23	.28	36.5	13.5	182.25
87	46	23	.64	27	4.0	16.00
42	46	23	.86	16	7.0	49.00
43	46	23	1.96	2	21.0	442.00
28	47	26.5	.75	21.5	5.0	25.00
30	47	26.5	1.07	12	14.5	210.25
27	48	29.5	.28	36.5	7.0	49.00
37	48	29.5	.33	34	3.5	11.25
45	48	29.5	.73	23	6.5	42.25
46	48	29.5	.14	42	12.5	156.25
78	49	34	.51	30	4.0	16.00
25	49	34	.80	18	16.0	256.00
26	49	34	.26	38	4.0	16.00
38	49	34	.76	20	14.0	196.00
41	49	34	.18	41	7.0	49.00
32	50	37.5	.75	21.5	16.0	256.00
36	50	37.5	.20	40	2.5	6.25
81	51	39.5	1.92	3.5	36.0	1296.00
40	51	34.5	.66	26	8.5	72.25

TABLE 11 (cont.)

Low and High-Anxiety Groups			Performance			
Subject	A-State	Rank 1	Score	Rank 2	D	D^2
29	52	41	1.04	14	27.0	729.00
73	53	42.5	.71	25	17.0	289.00
24	53	42.5	.83	17	25.0	625.00
						10039.00

n=43

$$r = 1 - \frac{6(10039.00)}{43(1848)} = \underline{.243}$$

alpha .05 =.364

TABLE 12

CORRELATION OF A-STATE AND PERFORMANCE FOR SUBJECTS WORKING UNDER ANXIOUS-INDUCED CONDITION

Low and High-Anxiety Groups			Performance			
Subject	A-State	Rank 1	Score	Rank 2	D	D^2
52	37	1	.29	37.5	36.5	1332.25
56	38	2.5	.30	37.5	33.0	1089.00
60	38	2.5	.28	40	37.5	1406.25
59	39	5	.60	5.5	.5	.25
64	39	5	.23	43.5	38.5	1982.25
67	39	5	.37	23	18.0	324.00
49	40	7.5	.35	27.5	20.0	400.00
57	40	7.5	.30	35.5	28.0	784.00
53	41	10	.69	3	7.0	49.00
63	41	10	.40	19.5	9.5	90.25
16	41	10	.60	5.5	4.5	20.25
47	42	12	.61	4	8.0	64.00
2	43	14.5	.37	23	8.5	72.25
18	43	14.5	.43	14.5	0	0
54	43	14.5	.24	42	27.5	756.25
62	43	14.5	.36	25.5	11.0	221.00
11	44	18.5	.36	25.5	70	49.00
15	44	18.5	.28	40	21.5	462.25
51	44	18.5	.46	10	8.5	72.25
65	44	18.5	.31	33.5	15.0	225.00
48	45	23	.44	11.5	11.5	132.25
61	45	23	.35	27.5	4.5	20.25
6	45	23	.51	7	16.0	256.00
14	45	23	.48	9	14.0	196.00
19	45	23	.87	1	22.0	484.00
3	46	28	.43	14.5	13.5	182.25
10	46	28	.28	40	12.0	144.00
21	46	28	.23	43.5	15.5	240.25
1	46	28	.34	29	1.0	1.00
58	46	28	.40	19.5	8.5	72.25
8	47	32	.43	14.5	17.5	306.25
17	47	32	.44	11.5	20.5	420.25
66	47	32	.73	2	30.0	900.00
50	48	36.5	.33	30	6.5	42.25
55	48	36.5	.37	23	13.5	182.25
7	48	36.5	.32	31.5	5.0	25.00
20	48	36.5	.49	8	28.5	812.25
4	48	36.5	.31	33.5	3.0	9.00
23	48	36.5	.43	14.5	22.0	484.00

TABLE 12 (cont.)

Low and High-Anxiety Groups			Performance			
Subject	A-State	Rank 1	Score	Rank 2	D	D^2
9	49	41	.32	31.5	9.5	90.25
12	49	41	.42	17.5	23.5	552.25
22	49	41	.42	17.5	23.5	552.25
13	50	43	.39	21	22.0	484.00
5	53	44	.29	37.5	16.5	272.25
						15760.00

n=44

$$r = 1 - \frac{6(15760.00)}{44(1935)} = \underline{-.112} \qquad \text{alpha } .05 = .364$$

A-State scores for the four different groups were not found to relate to the physiological parameter, heart rate changes. Also, no significant relationship was found between A-State scores and task performance scores of subjects who worked in the two experimental conditions. Tables 7, through 12 show the correlations which were found.

Mean performance scores and mean heart rate changes for each group were also calculated. and are shown in Table 13.

TABLE 13

MEAN PERFORMANCE SCORES AND

MEAN HEART RATE CHANGES

Group	High-Anxiety		Low-Anxiety	
Condition	Anxious-Induced	Non-Anxious	Anxious-Induced	Non-Anxious
Performance	.38	.76	.42	.97
Heart Rate	7.65	14.08	16.19	16.05

Summary and Interpretation of Results

In only three cases, performance differences were found to be significant. The LA group working in the non-anxious condition scored higher, i.e., peformed with more speed and accuracy on the mirror-tracing task than the HA group which performed in the anxious-induced condition (U = 80<152 @α= .05). No further differences in performance were found between the HA and LA groups. However, differences were found within these groups -- among subjects performing in the different task conditions. The LA group of subjects who worked in the non-anxious condition performed with more speed and accuracy on the task than the LA subjects who worked in the anxious-induced condition ($U = 84 < 146$ at $\alpha = .05$). The HA subjects who worked in the non-anxious condition were found to have performed significantly better than those HA subjects who worked on the novel task in the anxious-induced condition ($U = 158 < 162$ at $\alpha = .05$). The results lend partial support for the drive theory notion that subjects exhibiting higher levels of anxiety tend to perform with less speed and accuracy on skills, in situations which are emotionally arousing, than those subjects classified as possessing lower levels of anxiety.

The mean performance scores for each group presented in Table 13 indicates that the LA group which performed in the non-anxious condition achieved the highest performance mean score (.97). Also interesting to note is the fact that in both the LA and HA groups, subjects performing in the non-anxious condition achieved higher mean performance scores than their counterparts who performed in the anxious-induced condition.

The effort to find relationships between A-State and heart rate changes, and A-State and performance scores proved to be fruitless. Correlations were found to be low, and not indicative of a relationship existing in any of the cases. The highest correlation between A-State and heart rate change was found for the HA group of subjects which performed in the non-anxious condition ($r = .324$). Mean heart rate changes for the groups illustrated in Table 13 show that the LA subjects exhibited greater cardiac changes, between rest and performance, than the HA subjects. Statistically, however, no relationships were found to exist.

CHAPTER V

DISCUSSION

This study was designed to examine the performance of female subjects on a novel fine-motor task, specifically, mirror-tracing in two experimental conditions: (1) non-anxious and (2) anxious-induced -- with the threat of electric shock. The study was limited to UNC-G undergraduate students who participated on a voluntary basis. Following the establishment of subjects' A-Trait levels, subjects were assigned to a task condition. When subjects appeared for their test, A-State scores were obtained and baseline, or resting heart rates were recorded. While the subjects performed the task, the variables of time for completion, total number of errors, and heart rates were recorded. The differences between baseline and performance heart rates were calculated and later used in the correlations.

Performance

An understanding of the effect of anxiety upon skilled or unskilled performance is of great theoretical and practical importance (Lazarus, Deese, and Osler, 1952). People are often faced with the necessity to perform under conditions which are stressful, or anxiety-evoking. Such is obviously the case in competitive athletic events, situations requiring the learning of new skills, and also in military combat. The obvious fact that human beings are often required to work under stress does not call for further elaboration.

As was more concisely stated earlier, the purpose of this study was to investigate the performance of female subjects on a novel task, in differentially stressful conditions. As an extension of ideas germane to Hull's (1943) drive theory, later modified by Spence (1958), and called the "Reactive Hypothesis", Spielberger (1966) posited the "Trait-State Anxiety Theory". This was the pervading influence in the design of this study. Briefly, according to Spielberger, subjects with high A-Trait respond with high A-State levels, and, in situations which are characterized as threatening, perform more poorly than subjects with low A-Trait, under conditions that involve failure or negative evaluation of performance (Spence and Spence, 1966). Further, investigations of anxiety and learning under neutral and experimental conditions provide strong empirical support for the reactive hypothesis (Nicholson, 1958; Pearson and Thackeray, 1968; Sarason, 1960; Spence and Spence, 1966; Spielberger, 1966; Saltz, 1970).

The results of the experiment lend some evidence to support the reactive hypothesis, which poses that HA subjects are more essentially reactive than LA subjects, and respond with higher drive only in situations involving some form of stress. Consequently this higher drive would have a deleterious effect on performance. The most noticeable incidence of such an occurrence resulted between the HA group which performed in the anxious-induced condition, and the LA group which performed in the non-anxious condition, and achieved significantly higher performance scores than their HA counterparts. A possible explanation for this occurring is offered by Lacey (Lacey, Bateman, and Van Lehn, 1952; Lacey and Lacey, 1958) who suggests the presence of the concept of individual response specificity. This concept relates to the notion that each subject has his own method of adapting or responding to an anxious or stressful situation.

Further, according to the Trait-State theory, the effects of A-State on performance in a learning task depend upon the relative strength of the correct responses and competing error tendencies evoked by the task. On simple tasks, in which correct responses are stronger than error tendencies, high A-State would be expected to facilitate performance. On complex tasks, in which error tendencies are stronger than correct responses, it would be anticipated that high A-State would interfere with performance, particularly in the intial stages of learning (Spielberger, 1971). Therefore, the findings tend to support, in part at least, the merits of drive theory in deriving predictions regarding the effects of anxiety on motor behavior for women. It could be argued, however, as Martens (1971) has, that the tenability of drive theory is questionable because of the difficulty in determining the habit heirarchy -- since it changes as a function of practice. However, Martens notes that the difficulty in accurately predicting the effect of anxiety arises only in learning situations involving more than one response. Also, there is much experimental evidence available which supports the drive theory concept, when applied to skills (Belzer and Peters, 1972; Carron, 1968; Carron and Morford, 1968; Deese, 1962; Farber and Spence, 1956; Griffin, 1972; Martens and Landers, 1969; Noyes, 1971; Ryan, 1962; Taylor and Rechtschaffen, 1959; Vaught and Newman, 1966; Willis, 1967).

Physiological Parameters

Anxiety studies which have measured heart rate changes in learning and in stressful, or anxiety-induced conditions have found it to be highly related to emotional arousal (Andreassi and Whalen, 1967; Chase, Graham, and Graham, 1968; Danev and DeWinter, 1971; Deane, 1969; Harleston, Smith and Arey, 1965; Jacobson, 1938; Johnson and Campos, 1967; Moos and Engel, 1962; Wilson and Wilson, 1970).

Generally, Cattell (1963) has shown more rapid conditioning of the autonomic, or involuntary responses with higher anxiety. Forrest and Kroth (1971) have also shown that different psychometric indices of anxiety are associated with differential vascular responding, and only begin to differentiate between levels of anxiety after introduction to a stressful task -- thus lending support for Spence's (1958) "emotional reactivity hypothesis".

In the study herein described, threat of electric shock was used to induce anxiety, since its effectiveness in producing heightened autonomic nervous system (ANS) arousal has been accepted by others (Ax, 1953; Schachter, 1957) -- in particular, increases in heart rate were found for subjects who were informed they were in grave danger. Cardiac acceleration has also been observed to occur in heart rate conditioning prior to the onset of the unconditioned stimulus, typically a shock (Kanfer, 1958; Lacey and Smith, 1954; Obrist, Wood and Perez-Reyez, 1965; Zeaman, Deane, and Wenger, 1954). Also, Deane (1961) found that subjects told to expect shock during a long anticipation period responded with heart rate acceleration, even though they were never shocked. Thus it appeared that threat of shock was as effective in inducing ANS arousal as the actual presentation of the shock stimulus.

The data obtained in this study suggest that all the subjects experienced an increase in heart rate, and that the LA group had greater mean heart rate changes than the HA group (Table 4). Also, data revealed that the LA subjects working in different task conditions exhibited approximately equal increases in heart rate. On the other hand, the HA subjects performing in the non-anxious condition exhibited a mean increase of almost twice that of the HA subjects performing in the anxious-induced condition. A possible explanation for the overall increase in heart rate could be attributed to subjects' attenuation to the task at hand. Some of the available evidence seems to concur (Blatt, 1961; Campos and Johnson, 1966; Harleston, Smith, and Arey, 1965; Levinson, and Fenz, 1971), suggesting that the increase is caused by the general task demand to perform selectively and under time stress. In the experiment conducted, both of these criteria were used in evaluating subjects' performance.

The finding of cardiac acceleration among LA subjects performing in the anxious induced condition corroborates other evidence regarding heart rate acceleration in a situation of impending shock (Deane, 1969; Jenks and Deane, 1963). However, some studies have shown heart rate to decelerate prior to the presentation of the aversive stimulus (Deane, 1966; Lacey, Kagan, Lacey, and Moss, 1963; Zeaman and Smith, 1965). A similar trend was observed in this investigation wherein the HA subjects performing in the anxious-induced condition exhibited an average heart rate increase of 7.65 beats per minute (Table 13) -- the lowest mean increase of the four groups. Although this is obviously not a deceleration, Table 9 shows that two subjects exhibited cardiac deceleration and one subject experienced no change. Although this finding does not provide dynamic evidence, a noticeable trend is, nevertheless evident, suggesting the involvement of some physiological mechanism of adjustment. In this respect, Smith (1966) has suggested a homeostatic adjustment hypothesis which might be invoked to account for decelerations. Deane (1969), in summarizing a series of his experiments, concluded that the acceleration component is probably the response associated with anxiety and that the deceleration observed in his experiments may be associated with the preparation to "attend" to any type of stimulus event.

While increased ANS arousal in anticipation of shock has been observed in a number of studies, investigations of the relationship between personality measures and physiological indices of ANS arousal have consistently reported negative findings (Katkin, 1965; Lewinsohn, 1956; Taylor, 1953O. One possible explanation for this occurring is offered by Hodges and Spielberger (1966), who suggest that people differing in anxiety as measured by an instrument such as the MAS, may not differ in their cognitive appraisal of shock as threatening. Further, these authors found marked increases in heart rate for subjects threatened with shock. Contrastingly, the results herein discussed fail to show any tendency of a corresponding increase in heart rate.

In this respect, Spielberger (1966) has suggested that subjects who differ in trait-anxiety will respond with differential amounts of state-anxiety to "ego-stress" situations, but not to situations involving physical pain or threat of pain. Consequently, according to this view, HA and LA subjects would not be expected to show differential increases in heart rate to the stressor stimulus used in the present study. However, the results obtained suggest otherwise.

When A-State scores were correlated with performance scores, low relationships were found in both experimental conditions (Table 11&12). However, this finding does not necessarily discredit drive theory. In retrospect, the Trait-State theory poses that high A-State interferes with performance, particularly in the initial stages of learning. Therefore, it becomes evident that, since the subjects performing on the task were, by design, naive, and since their responses were of an initial nature, the positive correlation of the non-anxious group, although low in magnitude, is compatible with theoretical postulation. Further, the negative correlation found for the anxious-induced group, although low, corresponds with theory -- wherein higher levels in A-State predict a decrement in performance in stressful situations.

Although the results of this investigation are obviously short of providing dynamic support for the drive theory concept, this may partly be attributed to the fact that the majority of the available data concerning drive theory and its relation to performance has accrued from studies of male subjects. There is some research in the area of anxiety, however, which suggests that the sex of the subject is an important variable which should be given more consideration (Burton, 1971; Griffin, 1972; Jahnke, Cromell, and Morissette, 1964; Lushene, 1970; Quarter and Laxer, 1969). Since sex differences appear to exist with respect to anxiety phenomena and its effects on performance, it seems only logical that further controlled experiments, investigating the magnitude of these discrepencies be conducted so that some credible base for comparison can be established.

An interesting explanation is suggested by Forrest and Kroth (1971), who investigated the relationships between psychometric indices of anxiety (MAS and STAI) and vascular indices of arousal. Their results showed that low trait and low MAS subjects reflected a predisposition to respond to stress with heightened autonomic arousal. After introduction to the stressful task, the low trait and low MAS subjects exhibited diastolic blood pressure increases significantly higher than the HA subjects. The authors concluded that the LA subjects tend to avoid anxiety-evoking situations and therefore have not developed coping mechanisms to deal with stress. Therefore, when forced to confront these situations, they behave with considerable vascular arousal. A similar suggestion is forwarded by Kaplan (1966) in a therapy-like situation.

Consequently, in this study, it seems safe to assume that the HA subjects subjected to the threat condition have made use of their coping mechanisms, as posed by Lazarus (1966), and that the LA subjects, who have supposedly not developed these mechanisms, have responded with higher mean heart rate increases.

CHAPTER VI

CONCLUSIONS

Within the limits established for this inquiry, conclusions are offered to the questions posed in Chapter I. Also, considerations for future research are set forth.

Research Conclusions

1. Do subjects who work under a non-anxious condition perform with more speed and accuracy on the mirror-tracing task than subjects who work under an anxious-induced condition? The HA and LA subjects who worked on the mirror-tracing task under a non-anxious condition performed significantly better than the HA and LA subjects who worked on the task under an anxious-induced condition. This finding lends support to the reactive hypothesis theory.
2. Do HA subjects perform with more speed and accuracy on the mirror-tracing task than the LA group of subjects when both groups work in the non-anxious condition? No difference in performance was found between these two groups. Thus, this finding tends to conflict with drive theory, which suggests that HA subjects perform with more efficiency than LA subjects, in situations which are considered as not being emotionally arousing.
3. Do LA subjects perform with more speed and accuracy on the mirror-tracing task than the HA group of subjects, when both groups work under the anxious-induced condition? No difference in performance

was found between the LA and HA groups who worked in the anxious-induced condition. This finding also fails to lend support to the drive theory concept which suggests that LA subjects will perform better than HA subjects in situations considered to be emotionally arousing.

4. What is the relationship, if any, between state anxiety and the physiological parameter -- heart rate? No relationship was found to exist between A-State and heart rate changes. However, LA subjects showed greater mean difference than HA subjects. Thus, this finding tends to agree with the concept of the "coping process" which suggests that LA subjects respond with greater cardiac acceleration than HA subjects, particularly in stressful situations.
5. What is the relationship, if any, between state anxiety and performance on a novel task in an anxious-induced condition, and, in a non-anxious condition? No relationship was found to exist between A-State and performance in either the anxious-induced condition or the non-anxious condition. However, a negative relationship was found for the subjects performing in the anxious-induced condition. Although not significant, this finding tends to agree with drive theory notion that performance deteriorates in stressful situations.

Implications For Further Research

From the results presented, it is possible to deduce that the future of research on anxiety and motor behavior would seem to depend upon the development of appropriate motor tasks in which it is possible to assess the relative strength of correct and competing tendencies. It is also clear that, in investigations of the effects of stress on motor behavior, measures of A-State should be obtained in the experimental situation, or more practically, in the learning environment. Also, because of the element of "individual response specificity", forehand knowledge of a learner's potential for anxiety arousal, could aid the teacher in structuring a more suitable environment for the learning experience. In addition, the establishing of a reliable physiological indicator of A-State arousal could prove to be a most welcome tool to aid in environment control.

Essentially the results suggest a need for comprehensive and systematic, comparative research on affective variables associated with the effects of anxiety on performance and learning of motor skills among men and women. Within athletic and motor achievement situations a number of specific anxieties may possibly be examined. While very specific anxiety arousing situations may be studied, less specific situations may provide greater generality without losing the advantages of the situational anxiety approach. Perhaps developing a motor anxiety scale which uses statements specific to motor performance would contribute to the study of anxiety and motor learning.

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APPENDIX A

RAW SCORES

HIGH-ANXIETY SUBJECTS ASSIGNED TO PERFORM

IN THE ANXIOUS-INDUCED CONDITION

Subject	A-Trait	A-State	Time (sec.)	Errors	Performance Score	Heart Rate Resting	Heart Rate Performance	Heart Rate Difference
1	52	46	298	65	.28	96	100	4
2	52	43	215	15	.43	80	80	0
3	51	46	311	131	.25	72	66	-6
4	52	48	190	118	.32	112	124	12
5	52	53	265	78	.28	102	106	4
6	51	45	140	56	.52	90	96	6
7	52	48	162	41	.49	84	88	4
8	53	47	202	24	.44	76	84	8
9	53	49	188	52	.42	92	96	4
10	51	46	246	44	.34	98	102	4
11	52	44	156	62	.46	78	86	8
12	52	49	144	92	.42	82	80	-2
13	52	50	222	35	.39	94	100	6
14	51	45	214	72	.35	80	92	12
15	54	44	234	93	.31	94	110	16
16	52	41	138	28	.61	68	74	6
17	52	47	172	61	.43	74	80	6
18	51	43	210	57	.37	98	100	2
19	53	45	186	43	.44	66	78	12
20	51	48	252	66	.31	88	102	14
21	51	46	208	39	.40	82	100	18
22	54	49	227	83	.32	76	92	16
23	52	48	184	49	.43	68	72	4
					8.68			176
n=23					$\bar{X}$= .38			$\bar{X}$= 7.65

HIGH-ANXIETY SUBJECTS ASSIGNED TO PERFORM

IN THE NON-ANXIOUS CONDITION

Subject	A-Trait	A-State	Time (sec.)	Errors	Performance Score	Heart Rate Resting	Heart Rate Performance	Heart Rate Difference
24	51	53	111	10	.83	74	82	12
25	52	49	98	34	.76	98	118	20
26	51	49	292	93	.26	81	92	9
27	53	48	282	147	.23	96	110	14
28	52	47	115	18	.75	86	108	22
29	51	52	81	15	1.04	78	86	8
30	53	47	85	8	1.07	96	104	8
31	52	39	124	83	.48	88	100	12
32	54	50	86	47	.75	74	90	16
33	51	42	95	0	1.05	54	60	6
34	51	45	97	41	.72	78	84	6
35	52	41	697	212	.11	86	118	22
36	53	50	397	110	.20	80	98	18
37	55	48	200	99	.33	68	86	18
38	53	49	122	3	.80	76	98	12
39	53	41	56	3	1.69	58	70	12
40	52	51	51	1	1.93	66	87	21
41	51	49	174	21	.51	100	114	14
42	52	46	45	6	1.96	100	104	4
43	52	46	73	43	.86	82	92	10
44	53	43	304	133	.23	96	112	16
45	57	48	116	21	.73	88	102	14
46	53	48	445	255	.14	72	102	30
					17.43			324
n=23					$\bar{X}$ = .76			$\bar{X}$ = 14.08

LOW-ANXIETY SUBJECTS ASSIGNED TO PERFORM IN

THE ANXIOUS-INDUCED CONDITION

Subject	A-Trait	A-State	Time (sec.)	Errors	Performance Score	Heart Rate Resting	Heart Rate Performance	Heart Rate Difference
47	40	42	116	47	.62	78	92	14
48	39	45	145	65	.48	92	104	12
49	36	40	256	33	.35	86	96	10
50	40	48	196	72	.37	100	106	6
51	40	44	318	43	.27	96	110	14
52	38	37	288	59	.29	78	90	12
53	38	41	119	26	.69	82	96	14
54	40	43	346	71	.24	68	86	18
55	36	48	281	18	.33	88	104	16
56	35	38	311	24	.30	74	92	18
57	39	40	278	56	.30	72	88	16
58	39	46	212	18	.41	80	84	4
59	37	39	134	32	.60	64	78	14
60	40	38	306	47	.27	96	112	16
61	40	45	94	21	.87	86	102	16
62	37	43	232	45	.36	86	116	36
63	34	41	198	55	.41	76	92	16
64	40	39	370	64	.23	72	102	30
65	39	44	210	66	.36	82	100	18
66	39	47	118	19	.73	84	96	12
67	40	39	238	35	.37	76	104	28
					8.87			340
					$\bar{X}$ = .42			$\bar{X}$ = 16.19

n=21

LOW-ANXIETY SUBJECTS ASSIGNED TO PERFORM IN

THE NON-ANXIOUS CONDITION

Subject	A-Trait	A-State	Time (sec.)	Errors	Performance Score	Heart Rate: Resting	Heart Rate: Performance	Heart Rate: Difference
68	40	40	135	64	.50	90	98	8
69	40	41	99	29	.78	86	112	26
70	40	44	78	10	1.14	72	84	12
71	39	33	44	8	1.92	100	124	24
72	37	41	44	3	2.13	78	78	0
73	40	53	120	21	.71	108	124	16
74	38	42	62	11	1.37	86	100	14
75	38	40	50	7	1.75	82	97	15
76	38	40	100	0	1.00	76	94	18
77	40	46	222	46	.39	102	114	12
78	40	49	463	79	.18	78	88	10
79	37	46	302	56	.28	78	92	14
80	36	37	82	2	1.19	76	100	24
81	39	51	139	13	.66	84	100	16
82	39	45	126	57	.55	80	118	38
83	34	45	56	1	1.75	64	82	18
84	40	36	225	98	.31	84	92	8
85	38	40	110	55	.61	76	90	14
86	40	44	61	3	1.56	92	108	16
87	39	46	150	7	.64	82	110	18
					19.39			321
n=20					$\bar{X}$ = .97			$\bar{X}$ = 16.05

APPENDIX B

STATISTICAL FORMULAS

The Mann-Whitney U-Test*

Group 1		Group 2	
Score	Rank 1	Score	Rank 2
x_1	y_1	x_2	y_2
x_1	y_1	x_2	y_2
x_1	y_1	x_2	y_2
x_1	y_1	x_2	y_2
x_1	y_1	x_2	y_2
x_1	y_1		
	$\Sigma R1$		$\Sigma R2$
	n1		n2

$$U_1 = n1n2 + \frac{n1\ (n1 + 1)}{2} - R1$$

$$U_2 = n1n2 + \frac{n2\ (n2 + 2)}{2} - R2$$

Consultation with the appropriate table indicates if the calcùlated U value is significant or not.

* Siegel, S. Non Parametric Statistics for the Behavioral Sciences, New York: McGraw-Hill Book Co., 1956.

The Spearman (rho) Rank-Order

Correlation Coefficient*

Score 1	Rank 1	Score 2	Rank 2	Difference Between Ranks D	D^2
x_1	R_1	x_2	R_2	D	D^2
x_1	R_1	x_2	R_2	D	D^2
x_1	R_1	x_2	R_2	D	D^2
x_1	R_1	x_2	R_2	D	D^2
x_1	R_1	x_2	R_2	D	D^2
					ΣD^2

$$r = 1 - \frac{6 \Sigma D^2}{n(n^2-1)}$$

* Hays, W. L. Statistics For Psychologists, New York: Holt, Rinehart and Winston, 1963.

APPENDIX C

CORRESPONDENCE

UNIVERSITY OF SOUTH FLORIDA

TAMPA • ST. PETERSBURG

COLLEGE OF SOCIAL AND BEHAVIORAL SCIENCES
DEPARTMENT OF PSYCHOLOGY
TAMPA, FLORIDA 33620

813 974 2491

January 30, 1973

Mr. Michael Kich
1311-D Walker Avenue
Greensboro, N.C. 27412

Dear Mr. Kich:

Thank you for your letter which was recently forwarded to me from Florida State University. I was pleased to learn that you are considering using the STAI in your thesis research.

There are no definitive criteria for classifying subjects as high and low in state or trait anxiety. Some investigators select Ss who score in the upper and lower thirds or quartiles of their own samples, or, when the samples are large, in the upper and lower 20 percent. Others simply divide their Ss at the sampel median, but I do not recommend this approach.

An objective procedure for defining your high and low anxiety groups would be to use the norms that are provided in Table 2 (page 7) of the STAI Test Manual. Select the particular norms that most closely fit your own sample and determine the percentile scores for your high and low anxiety groups as you would like to define them. For example, scores of 30 and below, and 44 and above, would define the upper and lower A-Trait quartiles for male college undergraduates. The general procedure would be to select the approximate percentile rank that is indicated in the columns under the appropriate norm group and then determine the raw score in the margin of the table that corresponds to that percentile.

I am enclosing a copy of the published test form for the STAI, which may be obtained from Consulting Psychologist Press. If you decide to use the STAI in your thesis research, and do not have funds to purchase it, I will be happy to give you permission to reproduce the scale if you will fill out the enclosed permission form and have it countersigned by your faculty advisor. You need only return the original, the copies are for your advisor and your personal files.

Best wishes on your thesis research.

Sincerely,

Charles D. Spielberger
CHARLES D. SPIELBERGER
Professor of Psychology

CDS/fk

Enclosure

UNIVERSITY OF SOUTH FLORIDA

TAMPA • ST. PETERSBURG

COLLEGE OF SOCIAL AND BEHAVIORAL SCIENCES
DEPARTMENT OF PSYCHOLOGY
TAMPA, FLORIDA 33620

813 974-2491

February 14, 1973

Mr. L. Michael Kich
1311-D Walker Avenue
Greensboro, North Carolina 27412

Dear Mr. Kich:

In response to your recent request, I am pleased to give you permission to reproduce the State-Trait Anxiety Inventory for your thesis research on "Performance of a Novel Task Under Two Conditions of Anxiety". It is my understanding that your research will be carried out in the School of Health, Physical Education and Recreation of the University of North Carolina at Greensboro under the supervision of Professor Pearl Berlin.

By happy coincidence, it appears that I may be giving a colloquium in the Psychology Department at UNC-Greensboro later this spring. You might contact Professor Gaebelein of the Psychology Department regarding the date of my talk. The topic will be on Trait-State Anxiety Theory and Learning, and should be relevant to your own research.

I will look forward to learning more about your procedures and your results as they become available.

Sincerely,

Charles D. Spielberger

CHARLES D. SPIELBERGER
Professor of Psychology

CDS/dll

cc: Jacquelyn Gaebelein, Ph.D.
Assistant Professor and
Chairman, Colloquium Committee
The University of North Carolina
Department of Psychology
Greensboro, North Carolina 27412

APPENDIX D

STAI SCALES

A-Trait Scale

NAME ______________________________ DATE ______________

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21. I feel pleasant	1	2	3	4
22. I tire quickly	1	2	3	4
23. I feel like crying	1	2	3	4
24. I wish I could be as happy as others seem to be	1	2	3	4
25. I am losing out on things because I can't make up my mind soon enough	1	2	3	4
26. I feel rested	1	2	3	4
27. I am "calm, cool, and collected"	1	2	3	4
28. I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
29. I worry too much over something that really doesn't matter	1	2	3	4
30. I am happy	1	2	3	4
31. I am inclined to take things hard	1	2	3	4
32. I lack self-confidence	1	2	3	4
33. I feel secure	1	2	3	4
34. I try to avoid facing a crisis or difficulty	1	2	3	4
35. I feel blue	1	2	3	4
36. I am content	1	2	3	4
37. Some unimportant thought runs through my mind and bothers me	1	2	3	4
38. I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
39. I am a steady person	1	2	3	4
40. I become tense and upset when I think about my present concerns	1	2	3	4

A-State Scale

NAME ______________________________ DATE ______________

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you *feel* right now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	①	②	③	④
2. I feel secure	①	②	③	④
3. I am tense	①	②	③	④
4. I am regretful	①	②	③	④
5. I feel at ease	①	②	③	④
6. I feel upset	①	②	③	④
7. I am presently worrying over possible misfortunes	①	②	③	④
8. I feel rested	①	②	③	④
9. I feel anxious	①	②	③	④
10. I feel comfortable	①	②	③	④
11. I feel self-confident	①	②	③	④
12. I feel nervous	①	②	③	④
13. I am jittery	①	②	③	④
14. I feel "high strung"	①	②	③	④
15. I am relaxed	①	②	③	④
16. I feel content	①	②	③	④
17. I am worried	①	②	③	④
18. I feel over-excited and rattled	①	②	③	④
19. I feel joyful	①	②	③	④
20. I feel pleasant	①	②	③	④