Differences between anxiety patients and normals in phasic skin conductance reactions to heteromodal stimulation/

David Babcock Smith

University of Massachusetts Amherst

Follow this and additional works at: https://scholarworks.umass.edu/theses

Retrieved from https://scholarworks.umass.edu/theses/1975

This thesis is brought to you for free and open access by ScholarWorks@UMass Amherst. It has been accepted for inclusion in Masters Theses 1911 - February 2014 by an authorized administrator of ScholarWorks@UMass Amherst. For more information, please contact scholarworks@library.umass.edu.
DIFFERENCES BETWEEN ANXIETY PATIENTS AND NORMALS IN PHASIC SKIN CONDUCTANCE REACTIONS TO HETEROMODAL STIMULATION

A Thesis Presented
By
DAVID B. SMITH

Submitted to the Graduate School of the University of Massachusetts in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE
April 1976
Psychology
DIFFERENCES BETWEEN ANXIETY PATIENTS AND NORMALS IN PHASIC SKIN CONDUCTANCE REACTIONS TO HETEROMODAL STIMULATION

A Thesis Presented

By

DAVID B. SMITH

Approved as to style and content by:

Seymour Epstein, Chairman of Committee

Arnold Trehub, Member

Patricia Wisocki, Member

Jerome Myers, Chairman
Psychology Department
Acknowledgments

I would like to thank Sy Epstein, Arnie Trehub and Pat Wisocki for the help and support they gave me as committee members. I would like to thank Arnie and the other VA personnel especially for extending the use of the facilities at the hospital. I am also thankful for the help of Chris, Beth, Diane, and Ed who helped a great deal in setting up the lab, and the work of Lynne and Sally who typed the manuscript. Above all I am thankful for the support and patience of Susan, Cartney, Bonnie, Ginger, Lynne, and my family, all who were there when I needed them.
Table of Contents

Chapter I. Introduction ........................................... 1
   Problems of Experimental Approach ......................... 1
   Pathological Anxiety as a Defect of Inhibitory Capacity ... 3
   Pavlov: Heteromodal Stimulation and the Paradoxical Response ... 9

Chapter II. Method ........................................... 13
   Overview ................................................... 13
   Subjects .................................................. 13
   Procedure ............................................... 15
   Data Reduction and Analysis ... 20

Chapter III. Results ........................................... 27
   Physiological Measures .................................. 27
   Light Ratings ........................................... 37
   Results Following Further Selection by Manifest Anxiety ...... 40
   Group Differences on Personality and Other Variables ....... 42

Chapter IV. Discussion ......................................... 49
   Physiological Results .................................... 49
   Light Ratings ............................................. 65
   Causation: Physiological vs. Psychological Deficit .......... 67
   Chronic Pathological Anxiety, Manifest Anxiety, and Tonic Skin Conductance ......................... 68

Chapter V. Conclusions ...................................... 70
References................................. 72
Appendices................................. 78
List of Tables

Table 1. Group Differences on Personality Scales, Subject's Ages, Gradients of Phasic Change from the Low Light-Very High Noise Stimulus Combination to the Very High Light-Very High Noise Stimulus Combination, and Pre-experimental Skin Conductance; t-tests.................................................................43

Table 2. Trait Adjective Check List Data: Positive, Negative, and Combined Dimensions: N Normals = 9; N Anxiety Subjects = 9.................................45

Table 3. State Adjective Check List Data: Positive, Negative, and Combined Dimensions: N Normals = 9; N Anxiety Subjects = 9.................................47
List of Figures

Figure 1. Effects of light and noise levels on skin conductance averaged over blocks and groups: Range corrected phasic change.................................28

Figure 2. Habituation rates: The effects of blocks on range corrected phasic change averaged over all noise and light levels, for normals and anxiety patients.................................30

Figure 3. Effects of blocks on prestimulus tonic skin conductance averaged over all stimulus presentations, for normals and anxiety patients.........................31

Figure 4. Effects of light levels on skin conductance averaged over blocks with noise levels treated as background stimulation, for normals and anxiety patients: Range corrected phasic change. LN = low noise curve, MN = medium noise curve, HN = high noise curve, VHN = very high noise curve.................32

Figure 5. Effects of noise levels on skin conductance averaged over blocks with light levels treated as background stimulation, for normals and anxiety patients: Range corrected phasic change. LL = low light curve, ML = medium light curve, HL = high light curve, VHL = very high light curve.............33

Figure 6. Effects of light levels on skin conductance, with the very high noise treated as a background stimulus, averaged over blocks, for normals and anxiety patients..................................................35

Figure 7. Effects of noise levels on skin conductance, with the medium light treated as a background stimulus, averaged over blocks, for normals and anxiety patients..................................................36

Figure 8. Mean light ratings of light levels for all subjects, averaged over noise levels and blocks; and the effects of noise levels on mean light ratings for all subjects, averaged over light levels and blocks..................................................38

Figure 9. Ratings of light levels for normals and anxiety patients, averaged over noise levels and blocks; and the effects of noise levels on light
ratings for normals and anxiety patients, averaged over light levels and blocks..........................39

Figure 10. Variation of prestimulus tonic skin conductance with light levels, with the very high noise treated as a background stimulus, averaged over blocks, for normals and anxiety patients..............55

Figure 11. Effects of light levels on skin conductance, with the very high noise treated as a background stimulus, averaged over blocks, for the low conductance and high conductance groups..................57
CHAPTER I

Introduction

Experimental evidence on psychophysiological correlates of anxiety is equivocal. Some studies have reported differences in psychophysiological indices between anxiety and its absence or between anxiety and other emotional states (Odegaaard, 1932; Beam, 1955; Zahn, 1964), and others have reported no difference (Malmo & Shagass, 1949; Piercy, Elithorn, Pratt, & Crosskey, 1955; Lewinshon, 1956; Smith & Wenger, 1965). Of those reporting differences, many have reported opposite findings. Thus Odegaaard (1932), Wishner (1953), McDonnell and Carpenter (1960), Wing (1964), and Kelly (1966), using a number of different measures, reported finding that anxiety was correlated with low arousal or low reactivity, while Malmo and Shagass (1962), Martin (1956), Goldstein (1964), and Katkin (1965), reported finding high arousal or reactivity associated with anxiety.

Problems of Experimental Approach

Investigations into the physiological correlates of anxiety have approached the problem in three basically different ways. Investigators have: 1) manipulated the environment to induce a state of "anxiety" in the subject, comparing measures from before, during, and after the anxiety induction and/or used control groups (Ax, 1953; Szpiler & Epstein,
1974); 2) compared groups of "normals" that differed on a dimension of self reported anxiety (Beam, 1955; McDonnell & Carpenter, 1960; Rosenstein, 1962); or 3) studied differences between hospitalized patients and normals or between patient groups of different psychiatric diagnoses and symptomatology (Jurko, Jost, & Hill, 1952; Malmo, 1957, 1966; Lader, 1967). At least some of the confusion in this area can be attributed to a lack of conceptual clarity in keeping these approaches separate and to problems with the approaches themselves.

In the anxiety-induction studies there is some difficulty in assuming that the induced state should in fact be labeled as "anxious." Ax (1952), Lewinshon (1956), Shachter (1957), and Martin (1961) have all, at times, used the terms "anxiety" and "fear" synonymously. While fear and anxiety may be similar responses, there is some research that suggests that they are not identical. Epstein (1967, 1972) presents a theory of anxiety and fear that defines the experiences as similar but distinct, anxiety being defined as unresolved fear or the unavailability of an avoidance response in the presence of the perception of threat. If this is in fact the case, then any study assuming the identity of fear and anxiety can only produce confusing results.

With the second approach psychometric devices were employed to divide groups of normals into groups high and low on self reported anxiety. The Taylor Manifest Anxiety Scale or variations thereof have been the most common device. On
the whole, as some investigators have shown (Beam, 1955; Silverman, 1957; McGuigan, Calvin, & Richardson, 1959; Katkin, 1965), it is a dubious assumption that "manifest anxiety" can be directly related to chronic pathological anxiety. These authors have reported no physiological correlates of manifest anxiety as inferred from self report tests, although, as will be discussed below, there are reliable physiological correlates of chronic pathological anxiety. This review will therefore be restricted as closely as possible to studies in which groups of chronically anxious patients have been compared with control groups.

Pathological Anxiety as a Defect of Inhibitory Capacity

"Activation" or "arousal", a concept developed principally during the 1950's, refers to a continuum ranging from relaxed deep sleep to extreme emotional excitement. The concept, while related to overt activity, is not so defined but refers also to internal physiological activity. The development of the concept of activation has been closely tied to measures of cortical activity as modulated by the ascending reticular activating system (ARAS). Among researchers investigating the intensity dimension of behavior, the concept encompasses a broader meaning including the overall internal and external activity of the organism as it relates to its environment. Thus the usual measures of arousal have been baseline levels, rates of fluctuation, and rates of change of

Malmo (1957, 1966) has developed the viewpoint that anxiety is produced not by a heightening of a specific emotion such as fear or excitement, but by an inhibitory defect within the arousal system itself. In studies related to this notion two different approaches have been used, usually both within any one study. Measures of physiological activity have been taken while the subjects are in a "resting state", usually with the idea of testing whether anxiety patients are chronically overaroused. Measures have also been taken before, during, and after different kinds of specific stimulation, with the idea of measuring reactivity, adaptation, and change in rate over time. The first kind of approach, whether using levels of activity or degrees of fluctuation within any given response system has produced results which are at best equivocal. Some researchers have reported higher levels of activity in anxiety patients, supporting the notion of "overarousal" (Jurko, Jost, & Hill, 1952; Howe, 1958; Innes, Millar, & Valentine, 1952); some have reported lower levels (Sherman & Jost, 1952); and some have reported no difference (Davis, Malmo, & Shagass, 1954; Goldstein, 1964). Much of this confusion probably stems from differences in what experimenters refer to as the "resting period".

The second approach employs controlled stimulation of
subjects. It is in these studies that one begins to find coherent threads that show consistent differences between normals and anxiety patients. These findings point not to the conclusion that anxiety patients suffer from chronic over-arousal, but that when stimulated adequately, anxiety patients show a diminished capacity to inhibit arousal. These findings are based on the number of different kinds of procedures and measures.

First, patients suffering from chronic anxiety are slower to adjust to changes in experimental procedures than normals. Malmo, in collaboration with Shagass (1952) and Shagass and Heslam (1951) reports that the systolic blood pressure of a group of anxious patients continued to rise during a mirror drawing test and rapid discrimination test while normals, after an initial rise similar to that of anxiety patients, began to fall back toward prestimulus levels. A measure of heart rate yielded similar results. Innes, Millar and Valentine (1959) found that during standard psychiatric interviews groups of psychoneurotics and hypertensives showed the same initial rise in blood pressure as normals but then sustained those levels while the normals began to return to baseline. Wing (1964) employed a number of different measures of autonomic and skeletomuscular activity of anxiety patients and normals taken before, during, and after a difficult color naming task. With measures of baseline skin conductance, pulse rate, EMG levels, and number of spontaneous
fluctuations of skin conductance, she found that although levels of different measures were at times higher or lower for the different groups, all measures showed a significant difference in the rate of change during the final rest period with normals falling faster than anxiety patients. Skin conductance in the anxiety patients continued to rise during this time. While the Innes, Millar and Valentine study is open to interpretation that the interview was more stressful to the patients than the controls, the Wing study is not. The significant differences in the latter study were found with a color naming task which should not have been as stressful for patients, and were found during the final rest period when the procedure was clearly over. Venables (1956), subjected patients and normals to a simple nonaversive motor task (manipulating a pointer in response to lights) and measured skin conductance. Rubin (1964) used a cold pressor test and measured pupil size. Both found patient groups slower in returning to prestimulus levels of the respective response systems than control groups.

Measures of amplitude, duration, recovery, and habituation rate of autonomic and electromuscular responses to aversive and nonaversive discrete stimuli further support the notion that chronic anxiety is correlated with an inhibitory defect in the arousal system. These studies suggest that the defect consists of an incapacity to inhibit arousal under intense stimulation. Malmo, Shagass and Davis (1950) subjected
both anxiety patients and normals to a series of moderately loud (80 db above threshold) 1000-cycle tones, and continuously recorded EMG's from the extensor muscles of the right forearm. Patients and normals showed no significant difference in resting EMG before stimulation (averaged over all pre-stimulus measures) although patients tended to have somewhat higher levels, and again showed no significant difference in the rate of reaction through the first .2 seconds following stimulation. Beyond that point normals showed a steep decrease in muscle action potentials while the patients' EMGs continued to rise at the same rate for another .2 seconds before beginning to decrease, and then did so at a slower rate. EMG levels continued to be significantly different up to 13 seconds after stimulation. These findings were confirmed in another study by Davis, Malmo and Shagass (1954).

An interesting related study was done by Davidowitz et al. (1955). Subjects EMGs were measured from both arms while the subject was performing a push-button task with the index finger of one hand. While these researchers found no significant difference in muscle action potentials on the first trial, patients exhibited the same arousal level on the second trial, while the normals showed a marked decrease. The patients' potentials persisted for quite some time after the controls' subsided on each trial. Another interesting finding of this study was the five of the patients showed much
more bilateral muscle activity than did the normals.

Lader and Wing (1964) further elucidated the lack of inhibitory ability of anxiety patients by showing that patients fail to habituate nearly as rapidly to a series of auditory tones as do normals. The measure employed here was the amplitude of GSRs analyzed for the effects of groups, i.e. anxiety patients and normals, and for repeated stimuli. These findings held when the measure was corrected for the resting levels of each subject. Studies that further support the notion that chronic anxiety is associated with a relative inability to inhibit arousal have been done using other procedures and measures (Jurko, Jost, & Hill, 1952; Howe, 1958; Goldstein, 1964; Wing, 1964; Lader, 1967).

Malmo (1957), in a review of his studies mentioned above and others not reported here, concluded that chronic anxiety was produced by a defective regulatory mechanism of the arousal system, very possibly a result of impairment of central inhibitory mechanisms. In his 1966 review he concluded even more strongly that central inhibitory incapacity is at the roots of chronic anxiety but wondered how the excitatory and inhibitory processes interact to produce the total process in both normals and anxiety patients. Recent experiments reported below based on Pavlov's (1928) notions of cortical excitation and protective inhibition suggest how this interaction may function.
Pavlov: Heteromodal Stimulation and the Paradoxical Response

Pavlov (1928) viewed the central nervous system as being comprised of two distinct systems or processes, one of inhibition and one of excitation. Within the range of normal stimulus intensities, Pavlov assumed that increasing stimulus intensity would produce increasing arousal (cortical excitation). But, according to Pavlov, the cells of the cortex can only tolerate a certain amount of excitation before being damaged. He postulated the existence of a system of protective inhibition which would be activated when cortical excitation reached a certain level. He termed this process "transmarginal inhibition". When transmarginal inhibition is evoked, strong excitatory stimuli may elicit weaker responses than weak stimuli (the paradoxical phase). While these theories have been relatively ignored in this country, there does exist some support of the existence of paradoxical responses under intense arousal.

A series of studies on fear and its mastery in sport parachuting done by Epstein and Fenz are summarized by Epstein (1967). To quote from that summary:

From three different sources, namely, physiological reactions to a cue dimension of parachute-relevant words in a word-association test, subjective ratings of fear at different points in time before and after a jump, and physiological reactions before, during, and after ascent in the aircraft, the same finding emerged. Novice parachutists on the day of a jump produced steep monotonic gradients of fear and of physiological arousal as a function of a time and cue dimension, while experienced parachut-
ists produced inverted V-shaped curves, the peak advancing toward the remote end of the dimension with increasing experience. Longitudinal testing of individuals verified group data. The results could not be explained away by increased familiarity with the cues, as the phenomenon occurred only preceding a jump. Given the diversity of situations that produced the same relationship, and the astonishing degree of reliability of the findings, it was concluded that a fundamental principle had been uncovered. It was later learned that similar phenomena had been observed by Pavlov in dogs subjected to stress. . . (p. 85).

Epstein postulates a law of excitatory modulation (LEM) which states that "the gradient of inhibition as a function of increasing (or decreasing) excitation is steeper than the gradient of the excitation that it inhibits." While Epstein addresses himself principally to a theory of situational anxiety in this article and does not address himself specifically to chronic pathological anxiety, it seems plausible to postulate that chronic anxiety or "anxiety neurosis" occurs as a result of a breakdown in the law of excitatory modulation within an individual. In other words, the steepness of the gradient of inhibition is no longer such that the excitation produced by intense stimuli is effectively inhibited by the chronically anxious person.

Heteromodal stimulation. To test directly the existence of the paradoxical response a procedure was devised by Epstein, Szpiler and Alexander (1974) in which subjects were presented with 16 combinations of 4 intensities of light and sound (one zero level per mode), thus employing two separate
sense modalities. Five blocks of 16 pairs were presented. Phasic skin conductance reactions plotted as a function of increasing noise intensity with the highest light intensity as background formed an inverted V-shaped curve such that the response to the highest noise (90 db) was less than the second highest (83 db), clearly supporting the notion of paradoxical responses. Subjects' self-ratings of their reactions also supported the notion. Reactions to the high noise-high light combinations were lower than reactions to less intense combinations of stimuli.

A second study by Alexander, Epstein and Szpiler (1974) essentially repeated the procedure with the addition of a higher intensity of noise and light and the deletion of the zero level intensity for both modes. Again phasic change was shown to vary as a function of the interaction of noise and light. When phasic skin conductance reactions to light levels in block one were plotted with the very high light as the background, the reactions were shown to ascend to the medium light intensity and then fall back for the high and the very high light level. This inhibition increased over blocks to the point that in the third block the low light produced the largest response and the strongest light produced the weakest response. These findings certainly appear to be paradoxical.

Of great interest here is the fact that inhibitory capa-
city, i.e. the production of paradoxical responses, was found to correlate negatively with manifest anxiety. Here again is the suggestion that anxiety may be a relative incapacity to inhibit arousal, especially to stimuli intense enough so that non-anxious subjects show paradoxical responses to such stimuli. Although anxiety here is "manifest anxiety" rather than chronic pathological anxiety, it certainly seems logical to test the notion that "chronic pathological anxiety" (Malmö, 1957) is a relative incapacity to inhibit arousal to stimuli beyond the level where normals exhibit paradoxical responses.

The study presented in this paper essentially repeats the Alexander, Epstein and Szpiler (1974) study with two groups, one being a group of anxiety patients, the other being a control group. The study is designed to test whether anxiety patients, relative to normal controls, show an incapacity to produce paradoxical responses as heteromodal stimulation increases throughout the continuum of intensities. Assuming that the slopes of the curves of the magnitude of phasic change for both groups are similar up to the point where normals begin producing paradoxical responses, this would be strong evidence that anxiety patients exhibit a deficit in the inhibitory function of the arousal system.
CHAPTER II

Method

Overview

A patient group and a control group were presented three blocks of combinations of simultaneous light and noise bursts. Four levels (low, medium, high, and very high) of each stimulus modality were combined in pairs in a Latin square design creating 16 different heteromodal stimulus combinations presented once in each block. Subjects were asked to determine which light intensity they had been presented. Galvanic skin resistance was continuously recorded.

Subjects

Experimental group. The patient group consisted of three male out-patients and seven male in-patients at the Northampton Veterans Hospital, ranging in age from 26 to 38 years with a mean age of 30.4 years. Four of the men carried a diagnosis of anxiety neurosis and five a diagnosis of alcohol/drug addiction with underlying anxiety. The tenth man carried a diagnosis of chronic undifferentiated schizophrenia but was not at the time psychotic, nor had been for over a year. This man was known by the experimenter from a previous therapeutic relationship and was selected in spite of his diagnosis because he was at the time quite anxious. In personal interviews with the experimenter, all the men de-
scribed anxiety or nervousness as presenting the primary problem in living that they experienced.

Five of the men had been taking anti-anxiety medication, either Librium or Valium, which was suspended 48 hours before the experiment. Two men were on no medication because they were in the admission process. Both were medicated within hours after the experiment. The three remaining men had been off all medication for at least a week. None had been on phenothiazines for at least a month. None had any indication in their medical records of organic brain damage.

**Control group.** The control group consisted of 10 male employees of the hospital ranging in age from 23 to 41 years old with a mean age of 29.5 years. There was no significant difference in the mean ages of the two groups or the variance of ages of the two groups. All claimed that anxiety or anxiousness did not present a major problem in living to them although some claimed to be periodically anxious when faced with certain situations. Occupations within the group ranged from program psychologist to janitor.

Subjects in both groups were contacted personally by the experimenter 1 to 4 days in advance of the experiment. They were given a verbal summary of the experiment as described in the consent form (Appendix A), asked to read and sign the consent form, given a personality inventory type questionnaire (Appendix B) which included scales on manifest anxiety, pleasant excitement, fatigue, self-esteem, and cognitive integrity
(to be described in more detail later) and Eysenck's (1968) Introversion-Extroversion scale and Neuroticism scale. The only exceptions to this procedure were the two men who were in the admission process. Both were tested immediately after they consented and filled out the questionnaire. Originally, the experimenter planned to further select subjects along the manifest anxiety dimension by eliminating subjects in each group whose scores overlapped with scores from the other group, and then dividing subjects into two extreme groups based on the frequency distribution of remaining scores. Because of the difficulty in attaining subjects and because of demand characteristics within the experiment, it was decided to analyze the data both before and after selection. The procedure was such that anxiety patients may have been motivated to report higher manifest anxiety scores than they normally would have, and controls lower, to substantiate their claim that anxiety was or was not a major problem in living for them. Anxiety subjects may have been motivated to participate in the experiment due to an offer of four dollars, and some of the controls expressed a desire to participate out of interest in psychological research.

Procedure

Immediately after reporting to the laboratory subjects filled out two adjective check lists, one referring to their feeling state at the moment, and the other to their general
feeling state (Appendices C(1) and C(2) respectively). They were then seated in a comfortable stuffed chair in a sound and light dampened room, given instructions, and reassured by the experimenter if that seemed necessary. Subjects were told that they would be presented with simultaneous bursts of light and noise every 45 seconds for about one hour, that each burst would be preceded by a warning light, and that after each burst of stimulation a light would come on and the experimenter would ask the subject to give his best guess as to which of four light intensities had been presented, low, medium, high, or very high. The subject was further instructed to attend to the center of the reflective box he was facing and to try not to blink at the time he would be receiving a stimulus. He was told that if he did blink or for any reason felt he had missed the light he should indicate this to the experimenter and that the presentation would then be repeated at a later point. Electrodes were then attached, and the subject told that following a ten-minute dark adaptation period the practice presentations and experiment proper would begin. The experimenter then left the room.

Apparatus and stimuli. Subjects faced a reflective glossy white box which extended back toward them far enough that they could not easily avoid looking at some surface of it. The surface directly in front of them was approximately 4 feet from their eyes and had the words "low", "medium", "high", and "very high" inscribed on it. Above these words
in the center of the box was a small green warning light, and in the ceiling of the box was a low intensity bulb used to illuminate the light intensity scale and to indicate to the subject when he was to report his estimate of the light level.

The light source was a Vivitar 271 Photoflash mounted just above and behind the subject's head and directed toward the forward surface of the box. Intensities were controlled by a series of 4 transparencies of different densities mounted on a slide in front of the photoflash, generated to filter out percentages of the 1,000 lux seconds emitted by the photoflash within its .001 second flash. Actual levels of light energy received by the subject were .44, 4.4, 44, and 440 lux seconds, corresponding respectively to the low, medium, high, and very high lights.

The noise source was a tape of white noise amplified through a series of hi-fi amplifiers, and presented through the loudspeaker. The actual sound levels were 89 db, 94 db, 98 db, and 103 db corresponding to the low, medium, high, and very high noises respectively, the level being controlled with the volume switch on the first amplifier. Each burst of noise was presented for .1 seconds, beginning at the same point in time as the flash and lasting .099 seconds longer.

Stimulus levels were decided upon in the following way. Light levels were approximately the same as those in the Alexander, Epstein and Szpiler (1974) experiment, except that
the levels used in this experiment were set at one decibel intervals. These were only approximated in the former experiment. The result was that the low light was the same but the medium, high, and very high lights were all slightly higher in this experiment.

Noise levels were set by having 5 pilot subjects subjectively equate noise levels to each light level. Each subject made 10 estimates of noise intensity for each light level, in the following way. The burst of light was presented and followed 7 seconds later by either a 65 db or a 105 db burst of noise. The subject then indicated whether the noise should be increased or decreased and the procedure was repeated until the subject indicated that the stimulus levels were equal. The noise was changed by 5 db unless the subject indicated that a smaller change was needed, in which case 2 to 3 db changes were made. Smaller changes were possible but were rarely requested. The low (65 db) and high (105 db) initial noise burst trials were alternated and presented 5 times apiece for each light level. The median value for both the low and the high initial burst trials was then taken and averaged. This figure was then averaged across all subjects yielding the final noise levels.

The four levels of each stimulus modality were combined according to a Latin square arrangement, each of the 16 combinations being presented once each block. For each subject the order of presentation of combinations within each block
was determined by shuffling a deck of 16 cards representing each stimulus combination. The deck was shuffled at least 5 times before each block for every subject. There were three blocks so that each subject received 48 heteromodal presentations during the experiment proper.

Galvanic Skin Resistance (GSR) was recorded continuously using a Grass Model 5PI-A low level DC polygraph. The galvanic skin resistance input provided a 50 microampere polarizing current for the electrodes through a series resistance of 3 megaohms. For all practical purposes this is a constant current for electrode resistances up to a few hundred thousand ohms. Chlorided silver electrodes of 1 cm. diameter, with bentonite paste were used, attached to the index and ring finger tips of the right hand of the subject. A ground wire was attached to the right ear of the subject.

Experimental period. Following a 10 minute dark adaptation period, subjects were presented with the four light levels twice, once beginning with the low light and proceeding in order to the very high light, and once in the opposite direction. They were then given four practice presentations to familiarize them with the procedure. These presentations, the same for all subjects, were medium light-high noise, high light-low noise, very high light-medium noise, and low light-very high noise, in that order, so that in the practice presentations the subject was exposed to all noise levels. The subject was corrected if his light estimate was wrong during
the practice presentations.

The light and noise bursts, which were presented every 45 seconds, were preceded by a 10 second warning light and followed 7 seconds later by an overhead light, at which time the subject gave his light estimate. The overhead light was turned off once the subject gave his verbal response. The total time for presenting the three blocks of trials was 36 minutes plus 45 seconds for every presentation that had to be repeated if the subject blinked or manifested a response large enough to go off scale. Subjects were told that the presentations would continue for one hour to avoid the possibility that the subject's anticipation of the experiment ending would influence phasic reactivity.

When the three blocks of trials were completed, the subject was brought out of the room, thanked, paid, and told that the results of the experiment would be made available to him as soon as possible.

Data Reduction and Analysis

Physiological measures. Baseline and lowest resistance measures in ohms were extracted from the interval of 0.5 seconds past stimulus onset to 7 seconds past stimulus onset. The lowest resistance was recorded within this interval. The baseline level was defined as the highest resistance recorded prior to the low resistance point and following stimulus onset by at least .5 seconds. If the subject's resistance in-
creased throughout the interval both measures were taken at a point .5 seconds past stimulus onset. This procedure yielded a baseline and low-resistance measure for each of the 48 stimulus presentations for each subject. Each measure was then converted to conductance units (mhos).

A measure of the phasic change induced by each stimulus presentation was obtained by subtracting the baseline conductance level from the peak conductance level, which yielded 48 phasic change measures for each subject. Each measure was then range-corrected for each subject by dividing his 48 phasic measures in micromhos by that subject's largest phasic response. Range corrected phasic change and phasic change in micromhos were both analyzed.

A four-way repeated-measures analysis of variance was performed on the phasic change in micromhos, the range corrected phasic change and on tonic conductance (baseline) levels in micromhos. The independent factors were groups (patients vs. normals), blocks, light levels, and noise levels. All but the group factor were treated as repeated measures. The tonic conductance levels were analyzed in the same way as the phasic measures as a way of assessing what effects these levels might have on the phasic measures, but were not analyzed with any specific hypothesis in mind.

The following six predictions were made:

1) The main effect of noise—It was expected that as the stimulus intensity increased so would the
magnitude of phasic change.

2) The main effect of light--It was expected that as the stimulus intensity increased so would the magnitude of phasic change.

3) The main effect of blocks--It was expected that subjects would habituate to the stimulus presentations over the course of the experiment. The magnitude of phasic change was expected to decrease over blocks.

4) The interaction of groups and blocks--It was expected that normals would habituate to the stimulus presentations more rapidly than the anxiety patients. Although this prediction was not directly related to the heteromodal test of inhibition, it is related to Lader and Wing's (1964) finding that anxiety patients fail to habituate to discrete auditory stimulation at the same rate as do normals. While this phenomenon does not pinpoint the arousal system deficit of anxiety patients as specifically one of the inhibitory function rather than the excitatory, it can be attributed to an inhibitory incapacity if the heteromodal effects turn out as predicted.

5) The interaction effects of noise, light, and groups--It was expected that normals would pro-
duce significantly more paradoxical responses to heteromodal stimulation than anxiety patients. This was the primary prediction of the experiment. Since it was possible that the noise by light by group interaction might be significant but not reflect a group difference in the production of paradoxical responses, further analyses were planned if this factor was significant. These further analyses would include at minimum a three-way analysis of variance of phasic change for each level of light and noise, the factors being the other stimulus modality, blocks, and groups (thus if only the very high noise was being analyzed the factors would be lights, groups, and blocks). It was predicted that within these analyses the noise by group interaction and/or the light by group interaction effect would be significant at or beyond the .05 level of significance for the very high light and/or the very high noise respectively, with normals manifesting an inverted V-shaped curve and anxiety patients not.

6) Interaction effects of noise, light, group, and blocks--It was expected that the group differences in the production of paradoxical responses would increase over blocks.
Light ratings. Although the light-rating task was designed primarily to insure that the subject was attending to the light stimulation, the task provided a test of discrimination of light levels with background noise stimulation. Furthermore the task provided an opportunity to assess whether the predicted physiological heteromodal effects, if indeed found, would have behavioral correlates. Subjects' light ratings were converted to numerical values, i.e. 1 = low, 2 = medium, 3 = high, 4 = very high, and were analyzed in the same fashion as the phasic change measures. The following predictions were made:

1) Main effect of light--It was predicted that subjects would rate the lights accurately enough to produce an increasing gradient of light ratings as a function of increasing light intensities.

2) Interaction of noise and groups--It was expected that the background noise levels would interfere with the anxiety patient's light rating accuracy more than the normal's. Specifically it was expected that the anxiety patient's light intensity ratings would be influenced by the position within the range of noise intensities of the noise level presented. Thus they would rate the light level too high when presented with high noise levels and too low when presented with low noise levels. Normals were not expected to mani-
fest this confounding to the same degree as anxiety patients, if at all.

Scales and adjective check lists. As stated previously, a questionnaire was administered which included seven scales, the items of which are listed with the item's valence in Appendix B. The manifest anxiety, pleasant excitement, fatigue, self-esteem, and cognitive-integrity scales were all rationally constructed scales. Preliminary factor analyses and intrasubject consistency analyses of the first three scales indicate that the items do vary in relation to each other as expected and that subjects rate the different items consistently (Alexander, 1975). The self-esteem scale and the cognitive-integrity scale were devised just prior to the experiment and are untested. Each item on these five scales was rated on a scale of 1 to 5 by the subject and scored by summing all items.

The adjective check lists were scored in two ways. First, each dimension was treated separately yielding 19 separate scores. Second, complementary dimensions were combined, e.g. item 1, "frightened, worried, threatened"; and item 9, "secure, unafraid, unthreatened". The negatively worded item was subtracted from its positively worded complement, and 5 added to the score to insure it being a positive integer. Item 6, i.e. "self-accepting, good attitude toward self, warm feelings toward self", had no complement, so there were nine combined scores. Both the "now" and "in general"
adjective check lists were scores in the same manner. The numbers in parenthesis preceding the items in Appendix C(1) indicate the complement of that item.

All scale scores, adjective check list scores, the ages of subjects, a measure of a pre-experimental skin conductance in micromhos, range corrected phasic change to the low light-very high noise combination averaged over blocks, range corrected phasic change to the very high light-very high noise combination averaged over blocks, and the difference between the two phasic change scores (very high light-very high noise minus low light-very high noise) were tested to assess the differences between the normal and anxiety patient groups. The pre-experimental conductance score was extracted from each subject's record at the point of the first exposure to the low light following the ten minute dark adaptation period. The range corrected phasic change difference score was created to assess the range of gradients of phasic change produced in response to the very high noise level as the light stimulus level increased from low to very high. This last measure was created after the results of the analysis of phasic change had been reviewed.
CHAPTER III

Results

Results are presented here following the order of predictions presented above.

Physiological Measures

Range corrected phasic change was found to produce more reliable results than phasic change in micromhos and is thus the measure of phasic change referred to below unless otherwise indicated. The results of the analysis of tonic conductance will be presented where appropriate in evaluating phasic change.

Main effects of stimulus modalities. It was expected that both the noise and light factors would contribute significantly to the variance of phasic change. This was not the case. The noise factor was highly significant ($F = 34.32$, $df = 3$, $p = .001$), the magnitude of phasic change collapsed over light levels and blocks increasing as a function of increasing noise intensities. Phasic change also increased as a function of increasing light intensities but this effect fell short of statistical significance ($F = 2.14$, $df = 3$, $p = .11$). Figure 1 presents the main effects of noise and light levels in range corrected phasic change units.

Habituation rates: Main effects of blocks and interac-
FIGURE 1. Effects of light and noise levels on skin conductance averaged over blocks and groups: Range corrected phasic change.
tion effects of groups and blocks. As expected the block factor was highly significant \((F = 26.97, df = 2, p = .001)\) indicating that subjects habituated to the stimulus presentations. Phasic change averaged over all light and noise levels decreased sharply over blocks. The prediction that the group by block interaction would be significant, with anxiety patients habituating more slowly than normals, was not substantiated \((F = .22, df = 2, p = .81)\). Nor was the interaction of either stimulus modality with the group by block factor significant \((GBN, F = .91, df = 6, p = .49; GBL, F = .30, df = 6, p = .94)\). The variation of phasic change over blocks for both groups, averaged over noise and light levels, is presented in Figure 2. In the analysis of tonic conductance neither the block factor nor the block by group factor was significant \((B, F = .697, df = 2, p = .50, BG, F = 1.410, df = 2, p = .26)\), although as can be seen in Figure 3, which presents the variation of tonic conductance over blocks for both groups, anxiety patients manifest higher tonic conductance levels overall. Tonic conductance levels will be discussed in detail below.

Heteromodal effects. The expectation that the noise by light by group interaction would be significant was substantiated \((F = 2.02, df = 9, p = .04)\). Figure 4 presents each group's response to heteromodal stimulation, collapsed over blocks, as a function of light levels with noise levels treated as background. Figure 5 pre-
FIGURE 2. Habituation rates: The effects of blocks on range corrected phasic change averaged over all noise and light levels, for normals and anxiety patients.
FIGURE 3. Effects of blocks on prestimulus tonic skin conductance averaged over all stimulus presentations, for normals and anxiety patients.
FIGURE 4. Effects of light levels on skin conductance averaged over blocks with noise levels treated as background stimulation, for normals and anxiety patients. Range corrected phasic change. LN=low noise curve, MN=medium noise curve, HN=high noise curve, VHN=very high noise curve.
sents each group's responses as a function of noise levels with light levels treated as background. Three-way analyses of variance within each stimulus level, e.g. phasic change to the very high noise analyzed for the effects of groups, blocks, lights, and their interactions, indicated that the group differences in response to heteromodal stimulation were in the very high noise level (LG, F = 3.60, df = 3, p = .02) and the medium light level (NG, F = 6.53, df = 3, p = .001).

The groups differ most dramatically in response to the very high noise, medium light stimulus combination. This can be seen more clearly in Figures 6 and 7 in which the group curves for the very high noise and medium light are isolated. Further analyses revealed that the curve for the very high noise for anxiety patients was significantly cubic (F = 3.55, df = 1, p = .03). The same curve for normals showed no reliable trend of any kind. The curves for the medium light for both groups showed no reliable trends.

The data, while leading to the predicted significance of the noise by light by group interaction, did not conform to the expected group differences in the production of increasing paradoxical effects as the result of increasing heteromodal stimulation. Related to this, in that it was also predicted that the group differences in the production of paradoxical responses would increase over blocks, the noise by light by group by block interaction was not significant (F = 1.30, df = 18, p = .19).
FIGURE 6. Effects of light levels on skin conductance, with the very high noise treated as a background stimulus, averaged over blocks, for normals and anxiety patients.
FIGURE 7. Effects of noise levels on skin conductance, with the medium light treated as a background stimulus, averaged over blocks, for normals and anxiety patients.
Light Ratings

Main effects of light and noise levels. As expected, the light factor was highly significant \( F = 326.22, \text{df} = 3, p = .001 \) and in the expected direction, indicating that subjects were able to discriminate light intensities with some degree of accuracy. The noise factor, as was not predicted, was also highly significant \( F = 18.33, \text{df} = 3, p = .001 \) indicating that noise levels interfered with both groups' light rating accuracy. Subjects overall were influenced by the position, within the whole range of noise intensities, of the simultaneously presented noise burst, such that the light intensities were rated on the average too low when coupled with the lower noise levels and too high when coupled with the higher noise levels. Figure 8 presents the main effects of light and noise levels on the light ratings. Curves representing 100% accuracy are included to elucidate these effects.

Interaction effects of noise and light levels by group. As was expected the noise by group interaction was significant \( F = 3.40, \text{df} = 3, p = .025 \), with anxiety patients being more influenced by the relative position of the noise burst within the range of noise intensities than normals. As can be seen in Figure 9, which presents the light ratings as a function of increasing noise levels, both groups show this kind of influencing when presented the low and medium noise levels. The groups do not differ significantly in response to these levels (Low Noise, \( F = .30, \text{df} = 1, p = .59 \); Medium
FIGURE 8. Mean light ratings of light levels for all subjects, averaged over noise levels and blocks; and the effects of noise levels on mean light ratings for all subjects, averaged over light levels and blocks.
FIGURE 9. Ratings of light levels for normals and anxiety patients, averaged over noise levels and blocks; and the effects of noise levels on light ratings for normals and anxiety patients, averaged over light levels and blocks.

VALUES ASSIGNED TO S's LIGHT RATINGS

1 = LOW, 2 = MEDIUM, 3 = HIGH, 4 = VERY HIGH
Noise, \( F = .02, \text{df} = 1, p = .59 \). In response to the high and very high noise levels the groups do differ significantly (High Noise, \( F = 5.11, \text{df} = 1, p = .038 \); Very High Noise, \( F = 9.90, \text{df} = 1, p = .006 \), with normals rating the lights accurately and anxiety patients rating the lights too high.

The light by group interaction was also significant (\( F = 1.99, \text{df} = 3, p = .02 \), the groups differing significantly in rating the low light. Anxiety patients rated the low light significantly higher than did normals (\( F = 10.85, \text{df} = 1, p = .005 \)).

**Heteromodal effects.** No interaction containing both the noise and light factor was significant.

**Results Following Further Selection by Manifest Anxiety**

Two subjects' scores, one from each group, overlapped on self-reported manifest anxiety. Furthermore, one normal and one anxiety patient failed to return their questionnaires. The frequency distribution of scores not including the overlapping subjects yielded two extreme groups of six subjects each, after eliminating four subjects whose scores fell in the middle range. One group was then made up of normals reporting relatively low manifest anxiety (Mean = 14.7, Range = 5 to 20), the other composed of anxiety patients reporting relatively high manifest anxiety (Mean = 59.3, Range 48 to 75). All the above analyses were repeated with these two groups. The results of these analyses were similar to the
analyses with all subjects. All sources of variance which were significant in the primary analyses were so again with slightly less reliability. The one exception to this was the noise by light by group factor which reached the .06 level of significance. Since the number of subjects in each group was smaller, the power of the F-tests was reduced. Furthermore, the reduction in reliability of this finding (from p = .04 to p = .06) parallels the reliability reduction found in all other sources of variance. Therefore the results in both sets of analyses can be considered consistent.

In the primary analysis of tonic skin conductance levels, the group factor achieved only marginal significance \( (F = 2.94, \text{df} = 1, p = .10) \), with means for the normal and anxiety patient groups of 7.96 and 11.05 micromhos respectively. In the analysis following further selection by manifest anxiety the group factor was significant beyond the .05 level \( (F = 6.37, \text{df} = 1, p = .03) \) with means for the normals and anxiety patients of 6.45 and 11.70 micromhos. A t-test of the group differences (the groups formed by further selection of subjects on the manifest anxiety scores) was performed on measures of pre-experimental skin conductance, extracted from each subject's record at the point of their first exposure to the low light following the dark adaptation period. The means of the normal and anxiety patient groups (6.13 and 11.84 micromhos respectively) were significantly different \( (t = 2.06, \text{df} = 10, p = .03) \). Thus anxiety patients mani-
fested higher tonic conductance levels than normals, both before and during the experiment, when subjects were further selected by manifest anxiety scores. This finding is reported here because of its possible importance in interpreting the phasic change results.

**Group Differences on Personality and Other Variables**

Table 1 presents the results of t-tests performed on the scales included in the personality questionnaire, subjects' ages, and pre-experimental tonic skin conductance in micro-mhos. Also presented in Table 1 are the results of the t-tests performed on the measure of phasic change to the low light-very high noise, the measure of phasic change to the very high light-very high noise, and the difference between these two measures for each subject. As mentioned in the method section of this paper, these scores were included to assess the group differences in the gradients of phasic change produced in response to increasing light stimulation with the very high noise as background.

Anxiety patients scored significantly higher than normals on the "manifest anxiety" and "neuroticism" dimensions, and significantly lower than normals on the "cognitive integrity" and self-esteem" dimensions. Both groups manifested greater phasic change in response to the very high light-very high noise stimulus combination than in response to the low light-very high noise stimulus
<table>
<thead>
<tr>
<th></th>
<th>Normal N=9</th>
<th>Anxious N=9</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manifest anxiety</td>
<td>22.7</td>
<td>51.6</td>
<td>4.21</td>
<td>.001**</td>
</tr>
<tr>
<td>Pleasant excitement</td>
<td>52.0</td>
<td>48.2</td>
<td>.88</td>
<td>.39</td>
</tr>
<tr>
<td>Fatigue</td>
<td>14.6</td>
<td>17.1</td>
<td>1.24</td>
<td>.24</td>
</tr>
<tr>
<td>Extroversion</td>
<td>12.0</td>
<td>10.0</td>
<td>.76</td>
<td>.46</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>8.3</td>
<td>17.7</td>
<td>4.15</td>
<td>.001**</td>
</tr>
<tr>
<td>Cognitive integrity</td>
<td>30.2</td>
<td>17.0</td>
<td>3.51</td>
<td>.003**</td>
</tr>
<tr>
<td>Self esteem</td>
<td>20.7</td>
<td>10.1</td>
<td>2.74</td>
<td>.02*</td>
</tr>
<tr>
<td>Age</td>
<td>29.2</td>
<td>30.9</td>
<td>.71</td>
<td>.49</td>
</tr>
<tr>
<td>Range corrected phasic change;</td>
<td>Low light,</td>
<td>46.9</td>
<td>36.0</td>
<td>1.17</td>
</tr>
<tr>
<td>Very high noise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range corrected phasic change;</td>
<td>Very high</td>
<td>49.9</td>
<td>45.9</td>
<td>.50</td>
</tr>
<tr>
<td>Very high noise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gradient of phasic change ±</td>
<td>3.0</td>
<td>9.9</td>
<td>.61</td>
<td>.16</td>
</tr>
<tr>
<td>Pre-experimental skin conductance (micromhos)</td>
<td>8.32</td>
<td>10.78</td>
<td>1.01</td>
<td>.16</td>
</tr>
</tbody>
</table>

± Range corrected phasic change at the very high light - very high noise averaged over blocks, minus that at the low light - very high noise averaged over blocks.

* p < .05
** p < .01
combination. The anxiety group showed a greater mean difference between the two phasic change scores but this difference did not reach significance. The groups did not differ significantly on pre-experimental tonic skin conductance although, as mentioned above, when subjects were further selected by manifest anxiety scores, anxiety patients showed significantly higher levels than normals.

Table 2 presents the results of t-tests performed on the adjective check list data referring to subjects' feeling states in general (traits). All dimensions are listed with their complements, except item 6 which had no complement. The positive dimension, negative dimension, and combined dimensions were all tested and the results are reported as such. Dimensions are denoted by the first word of the item. Dimensions were combined such that the higher values represent more positive scores.

Scores on the positive, negative, and combined dimensions did not always distinguish between groups with equal reliability. Where only one of the single dimensions was significant, anxiety patients reported feeling less often happy, cheerful, and joyous; self accepting, having good attitudes about themselves, and having warm feelings about themselves; and calm, relaxed and at ease, than normals. The combined and negative scores of the "frightened, worried, threatened, -secure, unafraid, and unthreatened" dimension were significant with anxiety patients reporting feeling more often frightened than
<table>
<thead>
<tr>
<th>Trait Adjective Check List Data:</th>
<th>Positive, Negative, and Combined Dimensions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Normals = 9; N Anxiety Subjects = 9</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Means</td>
<td>t</td>
<td>p</td>
<td>Means</td>
<td>t</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>Anxious</td>
<td></td>
<td>Normal</td>
<td>Anxious</td>
</tr>
<tr>
<td>Secure, Frightened</td>
<td>3.7</td>
<td>2.8</td>
<td>1.71</td>
<td>.11</td>
<td>2.1</td>
</tr>
<tr>
<td>Items 9, 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Happy, Unhappy</td>
<td>3.7</td>
<td>2.4</td>
<td>2.97</td>
<td>.01**</td>
<td>2.3</td>
</tr>
<tr>
<td>Items 2, 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warm hearted, Angry</td>
<td>3.8</td>
<td>3.7</td>
<td>.26</td>
<td>.80</td>
<td>2.3</td>
</tr>
<tr>
<td>Items 4, 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energetic, Tired</td>
<td>3.7</td>
<td>3.0</td>
<td>1.41</td>
<td>.18</td>
<td>2.3</td>
</tr>
<tr>
<td>Items 5, 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self accepting</td>
<td>3.7</td>
<td>2.7</td>
<td>2.45</td>
<td>.03*</td>
<td>2.3</td>
</tr>
<tr>
<td>Item 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free, Frustrated</td>
<td>3.4</td>
<td>2.4</td>
<td>2.23</td>
<td>.05*</td>
<td>2.4</td>
</tr>
<tr>
<td>Items 18, 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worthy, Unworthy</td>
<td>3.8</td>
<td>2.6</td>
<td>2.61</td>
<td>.02*</td>
<td>1.7</td>
</tr>
<tr>
<td>Items 6, 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powerful, Powerless</td>
<td>3.7</td>
<td>2.9</td>
<td>1.61</td>
<td>.13</td>
<td>1.6</td>
</tr>
<tr>
<td>Items 12, 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calm, Tense</td>
<td>3.7</td>
<td>2.1</td>
<td>3.21</td>
<td>.007**</td>
<td>2.3</td>
</tr>
<tr>
<td>Items 19, 13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearminded, Confused</td>
<td>3.7</td>
<td>2.1</td>
<td>3.68</td>
<td>.002**</td>
<td>1.7</td>
</tr>
<tr>
<td>Items 14, 17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < .05
** p < .01
normals. On the "powerless, weak, helpless-powerful, strong, in command of one's fate" combined dimension, anxiety patients reported feeling powerful significantly less often than normals. Where all three dimensions reached significance, anxiety patients reported feeling less often free, unrestrained, and spontaneous; worthy, adequate, and pleased with themselves; and clear-minded, integrated, and in harmony with themselves than normals. They reported feeling more often frustrated, blocked, and inhibited; unworthy, inadequate, and displeased with themselves; and confused, disorganized, and fragmented, than normals.

Table 3 presents the results of t-tests performed on the adjective check list data referring to the subjects' feeling states at the time of the experiment. Anxiety patients reported feeling significantly less warm-hearted, kindly, and affectionate, than normals. The combined "unworthy, inadequate, displeased with self"-"worthy, adequate, pleased with self" dimension was significant with anxiety patients feeling less worthy than normals. The combined "confused, disorganized, fragmented"-"clear-minded, integrated, in harmony with self" dimension was significant, as was the negative dimension, with anxiety patients reporting feeling more confused. Where all three dimensions were significant, anxiety patients reported feeling less powerful, strong, and in command of their fates; less calm, relaxed, and at ease; more powerless, weak, and helpless; and more tense, jittery, and
Table 3
State Adjective Check List Data:
Positive, Negative, and Combined Dimensions:
N Normals=9; N Anxiety Subjects=9

| Secure, Frightened | Positive | | | Negative | | | Combined | |
|---------------------|----------|---|---|----------|---|---|----------|---|---|
|                      |         | t | p |          | t | p |          | t | p |
| Mean                | Mean    |   |   | Mean     |   |   | Mean     |   |   |
| Normal              | Anxious |   |   | Normal   | Anxious|   | Normal   | Anxious|   |   |
| Secure, Frightened  |          |   |   |          |   |   |          |   |   |
| Items 9, 1          | 3.7      | 2.7 | 1.66 | .12 | 1.5  | 2.2 | 1.65 | .13 | 7.1  | 5.7 | 1.60 | .13 |
| Happy, Unhappy      |          |   |   |          |   |   |          |   |   |
| Items 2, 7          | 3.0      | 2.2 | 1.67 | .12 | 1.8  | 2.8 | 1.69 | .11 | 6.2  | 4.4 | 1.83 | .09 |
| Warm hearted, Angry |          |   |   |          |   |   |          |   |   |
| Items 4, 3          | 3.0      | 3.2 | .45  | .67 | 1.3  | 2.7 | 2.41 | .03*| 6.7  | 5.6 | 1.14 | .27 |
| Energetic, Tired    |          |   |   |          |   |   |          |   |   |
| Items 5, 11         | 3.1      | 3.1 | 0.00 | 1.00| 2.3  | 2.4 | .16  | .88 | 5.8  | 5.6 | .12  | .90 |
| Self accepting      |          |   |   |          |   |   |          |   |   |
| Item 6              | 3.8      | 2.7 | 1.80 | .10 |      |     |      |     |      |     |      |     |
| Free, Frustrated    |          |   |   |          |   |   |          |   |   |
| Items 18, 19        | 3.1      | 2.6 | 1.03 | .32 | 1.67 | 2.78| 1.73 | .11 | 6.4  | 4.8 | 1.49 | .16 |
| Worthy, Unworthy    |          |   |   |          |   |   |          |   |   |
| Items 6, 10         | 3.8      | 2.9 | 1.86 | .09 | 1.44 | 2.56| 1.99 | .07 | 7.3  | 5.3 | 2.19 | .05*|
| Powerful, Powerless  |          |   |   |          |   |   |          |   |   |
| Items 12, 15        | 3.7      | 2.0 | 3.78 | .002**| 1.1  | 3.0 | 3.21 | .01**| 7.6  | 4.0 | 3.71 | .005**|
| Calm, Tense         |          |   |   |          |   |   |          |   |   |
| Items 19, 13        | 3.8      | 2.6 | 2.33 | .03*| 1.8  | 2.9 | 2.32 | .04*| 7.0  | 4.7 | 2.60 | .02*|
| Clearminded, Confused|        |   |   |          |   |   |          |   |   |
| Items 14, 17        | 3.4      | 2.7 | 1.40 | .18 | 1.2  | 2.9 | 3.29 | .009**| 7.2  | 4.8 | 2.43 | .03*|

*p < .05
**p < .01
nervous, than normals.
CHAPTER IV

Discussion

Physiological Results

Main effects of increasing stimulus intensities. The fact that increasing noise intensities significantly produced increasing phasic skin conductance reactions while increasing light intensities did not do so significantly is curious given that noise levels were subjectively equated to light levels. One possible reason for this is that the duration of the light stimulus was 1/10 that of the noise stimulus. Evidence from the Alexander, Epstein, and Szpiler (1974) study makes this interpretation doubtful. In that study stimulus durations were equal, yet noise levels were found to influence phasic change to a far greater extent than light levels. Another interpretation, suggested by the authors of the former study, is that the species is more sensitized to sudden noises than lights because sudden noises occur relatively more frequently in natural surroundings and are often associated with danger, while sudden bursts of light are rare.

Habituation rates. The results of this experiment clearly do not coincide with Lader and Wing's (1964) finding that anxiety patients habituate more slowly to repeated stimuli than do normals. Both groups habituated to the stimuli and there was no significant group difference in rate of habituation. There are three differences in experimental procedure
that could account for the difference in findings. First, Lader and Wing presented an unvaried stimulus repeatedly, while stimulus intensities were varied in this experiment. Based on this difference one could argue that habituation to stimuli of varied intensity is a more complex process and that somehow this complexity equalized the two groups. Yet both groups did habituate effectively so that if the argument is carried through, one must argue that anxiety patients show an inhibitory deficit in simpler environments but are able to inhibit as well as normals as the environment becomes more complex. (Following the views of Pavlov (1928) and Epstein (1967), habituation is viewed here as an inhibitory phenomenon. Epstein refers to the phenomenon as "adaptation".) Attributing the different findings to the second difference in experimental procedure, that is, single mode stimulation as opposed to heteromodal stimulation, leads one to the same conclusion. Anxiety patients manifested slower habituation rates than normals to single mode stimulation but not to heteromodal stimulation. Thus one must argue again that anxiety patients show an inhibitory deficit in simpler environments but are able to inhibit as well as normals as the environment becomes more complex.

The third difference suggests a more reasonable interpretation of the two sets of findings. Lader and Wing presented stimuli at preset varied intervals, while stimulation in this study was presented at fixed 45-second intervals pre-
ceded by a 10-second warning light. The cues built into the experimental procedure may have provided enough structure to allow anxiety patients to build expectancies and thus inhibit arousal to the repeated stimulus presentations. This inhibition of physiological arousal is thus seen as psychologically mediated as opposed to reflexive. On the other hand, in the Lader and Wing study, predictability was not built into the procedure and thus "robbed" the anxiety patients of the cognitive map they needed to psychologically modulate arousal. Presumably the normals were able to psychologically modulate arousal without needing the external cues. This interpretation seems more reasonable than the former and is consistent with the theory that people who suffer from chronic pathological anxiety are deficient in their ability to inhibit arousal. Here this deficit is seen as a deficit in cognitive processing of information. This phenomenon will be discussed more in interpreting the heteromodal effects of phasic change.

Another possible explanation of the differences in findings is that Lader and Wing's results are simply unreliable or lack general applicability. For example, the phenomenon may have been a spurious result of some aspect of their experimental procedure, or the phenomenon may be related only to a loud auditory stimulation but not applicable to the phenomenon of habituation in general.

**Heteromodal effects.** The prediction that the noise by light by group interaction would be significant was substan-
tiated, but further analysis indicated that this effect was not due to the production of paradoxical responses by normals and the lack thereof by anxiety patients, as stimulus intensities increased. The primary prediction of this study, as stated in the introductory remarks (pg. 12), was not substantiated.

The study is designed to test whether anxiety patients, relative to normal controls, show an incapacity to produce paradoxical responses as heteromodal stimulation increases throughout the continuum of intensities. Assuming that the slopes of the curves of the magnitude of phasic change for both groups are similar up to the point where normals begin producing paradoxical responses, this would be strong evidence that anxiety patients exhibit a deficit in the inhibitory function of the arousal system.

This "evidence" was not forthcoming. The question then is how to interpret the obtained results. But before looking at the specific curve forms, the question of the effect of group differences in tonic skin conductance on the phasic change measures must be addressed.

As mentioned above, the primary analysis of tonic conductance revealed a group difference that fell short of significance. After further selection by manifest anxiety scores this difference became more statistically significant with means of 6.45 and 11.7 micromhos respectively, for the normal and anxiety groups. Given these findings, the possibility must be entertained that the group heteromodal effects reflect the difference in tonic conductance rather than an
independent phenomenon.

One possibility is that because the anxiety patients had significantly higher tonic conductance levels than normals, they may have been pressing the limits of autonomic reactivity, and, as a result, produced phasic changes of less magnitude than normals. While, as will be argued below, it is likely that a reflexive homeostatic regulatory mechanism is called into play in response to the anxiety patient's over-arousal, this does not provide an acceptable explanation of the group differences in heteromodal effects found in this experiment. Correlation coefficients describing the relationship of tonic conductance levels and range corrected phasic reactions to this stimulus presentation in all blocks were all moderately positive but not significantly so. The coefficients describing the relationship of tonic conductance and phasic change in micromhos were also positive and significant beyond the .05 probability level. The anxiety patients were more reactive, not less so, to the very high noise-medium light stimulus combination, in response to which the groups showed the greatest difference in phasic change.

Further evidence suggests that in fact the group difference in response to heteromodal stimulation is a phenomenon independent of the group tonic conductance levels. As will be recalled, a four-way analysis of variance was performed on tonic skin conductance levels. Since these were in effect pre-stimulus levels, extracted at .5 seconds past stimulus
onset and thus within the latency period of the skin conductance response, no effects of stimulus presentations were expected. In fact, none achieved or approached significance. Of more importance, Figure 10 shows the tonic conductance curves for the very high noise, revealing that tonic conductance varied negligibly over the course of increasing light intensities. Thus the same curves of phasic change could not reflect chance variation in tonic conductance levels.

To assess more directly the effect of tonic conductance levels on phasic responses to heteromodal stimulation, subjects were divided into two groups on the basis of pre-experimental skin conductance measures, extracted at the subject's first exposure to any stimulus (at the point of the low light presentation following the dark adaptation period). The eight subjects having the lowest levels formed a low tonic conductance group (Mean = 4.24 micromhos, Range = 3.30 to 5.35 micromhos). The eight subjects having the highest levels formed a high tonic conductance group (Mean = 15.02, Range = 11.75 to 19.23 micromhos). All the original analyses of phasic change were then repeated using these two groups in place of the normal and anxiety patient groups. In the primary four-way analysis of variance, groups, blocks, lights, and noise being the four factors, no source of variance including the group factor achieved or even approached significance. Nor did any heteromodal source of variance approach significance. In the three-way analysis of variance
FIGURE 10. Variation of prestimulus tonic skin conductance with light levels, with the very high noise treated as a background stimulus, averaged over blocks, for normals and anxiety patients.
of tonic conductance in response to increasing light levels with the very high noise as background, the group by light interaction was not significant. Figure 11 presents the curves produced by each group in response to increasing light levels with the very high noise as background. As can be seen, these curves do not resemble the curves produced by the normal and anxiety patient groups.

The weight of the evidence then points to the interpretation that both the heteromodal phasic change effects found in the very high noise level, and the group differences in tonic skin conductance levels are phenomena related to states of chronic pathological anxiety or its absence, but that the heteromodal effects on phasic reactivity are not a function of the difference in tonic conductance levels.

The question is still then how to interpret the heteromodal effects. It will be recalled that the very high noise curve for the anxiety patients was significantly cubic. From the low to medium light levels the patients showed a steep increase in the magnitude of phasic change. The increasing light intensity was facilitative up to the medium light—very high noise level. Beyond this point a further increase in the intensity of stimulation produced what might be interpreted as an inhibitory effect such that phasic conductance reactions to the high light and very high light with the very high noise as background were considerably less than those to the medium light. Thus the anxious group, not the normal
FIGURE 11. Effects of light levels on skin conductance, with the very high noise treated as a background stimulus, averaged over blocks, for the low conductance and high conductance groups.
group, produced the paradoxical responses. It is interesting to reflect on the steepness of the increase in phasic change from the low to medium light levels and to extrapolate the result of increasing intensities if no paradoxical effect had been produced. As it is, the anxious group's responses to the medium light at the very high noise level were the responses of greatest magnitude found in the experiment. If the gradient had continued to increase with increasing levels of light stimulation, the anxiety group would have far exceeded the normal group at the most intense stimulus level.

The normal group on the other hand produced no reliable paradoxical responses at this noise level. While it did show a fairly steep drop in phasic change from the low to the medium light, it will be recalled that this curve showed no reliable trends and thus reflected a fair amount of random noise or error variance. Probably the safest assumption, given the unreliability of the curve form, is to assume a shallow increasing gradient of phasic change with increasing light stimulation. It appears then that anxiety patients, whether because of a defect either in inhibitory or excitatory function, reach levels of reactivity under moderate stimulation such that any further increase in stimulation elicits inhibitory responses, while normals do not as readily reach levels of reactivity that would necessitate this form of inhibition.

In reviewing his research on fear, anxiety, and arousal
in sport parachutists and the work of Lacey (1956) and Wilder (1957), Epstein postulates that the organism has three lines of defense at its disposal against overarousal. The three lines of defense are the psychological inhibition of fear, the inhibition of physiological arousal through psychological responses, and the reflexive homeostatic physiologically mediated inhibition of arousal. This model suggests a possible interpretation of the findings above. Because, however, it is impossible to point directly to any inhibition on the part of the normal group, this interpretation is highly speculative at best.

The first line of defense is not applicable to this analysis but the second and third are. One can speculate that the normals did not reach the levels of reactivity that the anxiety patients did because they were able to rely on the second line of defense. They were able to psychologically inhibit reactivity such that they did not press the limits of the system. On the other hand, anxiety patients were not able to rely on this second line of defense, just as the patients in Lader and Wing's (1964) study could not, and thus did in fact activate the final emergency line of defense, i.e., a reflexive physiologically mediated inhibitory mechanism. They were pushing the limits of the system and the system responded such that further increases in intensity produced inhibition, akin to the phenomenon Pavlov (1928) called "transmarginal inhibition."
Some peripheral evidence exists in the analysis of the scales to support this notion. The anxiety patients and normals differ significantly in "cognitive integrity". This scale was partially comprised of six adjectives rated on a scale of 1 to 5 in terms of how often the subject felt the feeling described. The negatively valenced items were "confused", "bewildered", and "disorganized", and the positively valenced items were "clear-minded", "all-together", and "organized". There were also six statements rated on a scale of 1 to 5 in terms of how strongly the subject agreed with them. The negatively valenced items were 1) "I often have trouble figuring out what I should do, or what I want to do"; 2) "I often feel disorganized and confused"; and 3) "I do not like being in completely new situations". The positively valenced items were 1) "I am fairly good at adapting to new situations"; 2) "I am usually capable of making clearly thought-out decisions"; and 3) "I usually feel fairly put together and on top of things". While this scale is untested in terms of reliability and validity, on the face of it the anxiety patients are saying that they are relatively more confused, fragmented, disorganized, and less able to assimilate and effectively deal with the data of experience than normals. The relative lack of integration and efficiency of the anxiety patients' cognitive processes can be seen as reflected in their inability to produce psychological responses that would have inhibited reactivity.
No data were collected that would indicate what psychological responses normals were producing that did inhibit reactivity. One possibility is that the normals, because of their relatively greater capacity to organize and assimilate the data of their experience, were more able to remain absorbed in the light rating task than the anxiety patients. Thus while the normals may have been successfully anticipating the stimulus presentation, counting seconds, forming more refined cognitive "maps" of the different light and noise levels, or whatever, anxiety patients may have been doing so less successfully and thus been more startled by the stimulus presentations. This interpretation is tenuous and remains so even with the support of group differences in cognitive integrity. As mentioned above, because normals do not show any direct evidence of psychologically mediated inhibitory responses, the only clear findings in the data are that normals do not produce any paradoxical responses while anxiety patients do, and that normals function at lower levels of tonic arousal in general without reference to specific stimulation.

In light of the findings of Epstein, Szpiler, and Alexander (1974), and Alexander, Epstein, and Szpiler (1974) indicating that normals (college students) produce paradoxical responses with increasing levels of heteromodal stimulus intensities, the fact that the normals in this study did not produce paradoxical responses warrants discussion. The noise levels in the above studies were 0, 74, 83, and 90 db,
and 74, 83, 90, and 104 db, respectively, while the noise levels in this study were 89, 94, 98, and 103 db. The former studies presented a wider range of noise intensities, the mode that consistently effected phasic change more than the light mode. The present experiment, by presenting a narrower range of noise intensities, may not have provided enough stimulation at the upper end of the dimension to elicit clearly inhibitory responses from normals.

It should also be pointed out that the room used in this experiment was sound dampened but not acoustically shielded as was the chamber used in the previous two studies. Therefore, background noise levels in this experiment were quite a bit higher, and may explain why the noise levels, set by subjective equation to light levels, encompassed a narrower range than in the previous studies with the difference at the lower end of the dimension. Thus not only was the range narrower, but the stimulus levels were presented in a noisier environment, providing less contrast, and possibly taxing less the subjects' defenses against overreactivity.

Another explanation for the discrepancy in findings may be in the duration of the light flash used in these studies. In the two former studies a .5 second flash was presented, while in the present study a .001 second flash was presented. The quicker flash was used in this study specifically to control for the possible effects of eye blink reflexes. With the .001 second flash it was not possible for an eye blink,
elicited by the flash, to occur during the flash interval and thus eliminate some of the stimulation. With a .5 second flash this was a possible problem since the latency of the eye blink reflex is less than .5 seconds. It is possible that the production of paradoxical responses by normals in the former studies were the result of eye blink reflexes elicited by the very high light, and not by the lower intensity lights. This might explain why the paradoxical responses were produced in response to increasing light levels with noise levels treated as background stimulation.

The lack of paradoxical responses produced by the subjects who rated themselves high on manifest anxiety in the Alexander, Epstein, and Szpiler (1974) study may have been the result of a longer latency of the eye blink reflex associated with anxiety states. No clear cut body of literature exists to support the notion that either longer or shorter reaction times or latencies of any response system are associated with anxiety states.

In summary, then, the interpretation of the heteromodal effects found in this experiment is as follows: Anxiety patients showed a steep increase in the magnitude of phasic responses from the low to the medium light levels when the very high noise was a background stimulus, because of a deficit in the production of psychologically mediated inhibitory responses. In response to yet more intense stimulation they presumably relied on the third and emergency line of de-
fense that the organism has at its disposal to protect itself from overreactivity, the activation of a reflexive homeostatic regulatory mechanism. It was the activation of this mechanism that produced the decreasing gradient and leveling off of phasic change at stimulus levels beyond the medium light level. This phenomenon appears to correspond with what Pavlov (1928) called "transmarginal inhibition." Normals, on the other hand, were able to produce psychologically mediated inhibitory responses that prevented the activation of the emergency line of defense. This is admittedly quite speculative because there is no direct evidence of this inhibition in the curves produced by the normals.

Assuming the explanation that the paradoxical responses found in the two former studies are related to eye blink reflexes is not valid, the paradoxical responses produced by normals in these previous two experiments may be interpreted as a manifestation of psychologically mediated inhibition. The paradoxical responses produced by anxiety patients in this experiment may be interpreted as reflecting the activation of a homeostatic physiological regulatory mechanism in response to threatened overreactivity. The normals in the Alexander, Epstein, and Szpiler (1974) study, who rated themselves high on manifest anxiety and produced fewer paradoxical responses than the normals who rated themselves low on manifest anxiety, are seen as an intermediate group in level of anxiety. They are less anxious than patients with clinical
symptoms of anxiety. While they were less able psychologically to inhibit arousal under intense stimulation than the low manifest anxiety group, they were not so incapacitated as to reach levels of arousal that would activate the third line of defense against overreactivity, i.e. a homeostatic regulatory mechanism. This interpretation presents the rather severe experimental problem of determining which paradoxical responses reflect which type of inhibition. Yet in light of the findings of the three studies this appears to be a plausible interpretation.

**Light Ratings**

The results of the light rating task indicate that both groups were systematically influenced by noise levels. The direction of the influence was related to the position of the particular noise burst within the range of noise intensities, such that subjects rated the lights too low when presented with the lower noise bursts, and too high when presented with the higher noise bursts. Anxiety patients were significantly more influenced than normals by the high and very high noise levels, ratings lights significantly higher than normals when presented with the high and the very high noises. This group difference increased from the high to the very high noise level. Anxiety patients were significantly more influenced than normals by the noise levels when rating the low light.

The finding that anxiety patients performed less well
than normals is consistent with the literature on arousal and performance of many different kinds of tasks (reviewed by Duffy, 1972). This literature indicates that there is an optimal level of arousal at which performance is best, and that either lower or higher levels of arousal are associated with declining performance. Given that the anxiety patients in this experiment were overaroused as indicated by tonic conductance levels, they would be expected to perform less accurately.

The particular pattern of inaccuracy or systematic influence of the noise levels is quite interesting. The fact that the influence of noise levels is not absolute, but is relative to the position of each noise level within the range of noise levels, suggests that subjects form a cognitive map of each set of stimuli (light and noise) and then to a lesser or greater degree manifest a confounding of the two maps. The fact that anxiety patients manifest more confounding is consistent with their self-reported lack of cognitive facility or integration. The finding that group differences increase with increasing levels of interfering stimulus intensities is consistent with the notion that anxiety patients are less able than normals to modulate arousal as stimulation increases. The degree of inaccuracy was circumscribed in this study by the fact that subjects rated the four lights on a scale of 1 to 4. Subjects could not rate the low light too low or the very high light too high, nor could they rate the
high light more than one step too high, and so on. Had the limits of error not been so circumscribed, it is possible that the group differences would have been increased.

Causation: Physiological vs. Psychological Deficit

In Malmo's (1957, 1966) speculations as to whether chronic pathological anxiety reflects a deficit in inhibitory or excitatory function, the implication suggested a physiological deficit rather than a psychological one. Based primarily on group differences in the self-report data collected in this experiment, this assumption seems open to question.

Based on the group difference in tonic conductance levels found in this study, the conclusion that chronic pathological anxiety is a state of generally heightened physiological arousal seems warranted. The interpretation of this phenomenon presented here is that this heightened arousal is the result of the anxiety patients' inability to produce psychologically mediated inhibitory responses. This cognitive or psychological deficit is seen as reflected in anxiety patients' lower self-reported cognitive integrity and in their relative inability to accurately rate the light levels. This psychological deficit is also seen as reflected in the anxiety patients' presumably forced reliance on a homeostatic physiologically mediated regulatory mechanism, based on the paradoxical effect of phasic skin conductance reactions to increasing heteromodal stimulation produced by this group.
This interpretation can be countered by the opposite interpretation that because of a physiological deficit in the modulation of arousal, anxiety patients are chronically overaroused. This overarousal in turn interferes with cognitive functioning and thus anxiety patients report relatively less cognitive integrity than normals and are less accurate at discriminating light levels. This study does not provide the data that would allow a choice between these interpretations. Implied in a combination of these two interpretations, ignoring the question of the original or root deficit, is a positive feedback loop of overarousal and cognitive deficiency that paints a rather poignant picture of the cyclical process behind the anxiety patient's suffering.

Chronic Pathological Anxiety, Manifest Anxiety, and Tonic Skin Conductance

As was discussed in the introduction, in the body of literature on anxiety and its relationship to arousal, tonic or baseline levels of different response systems have not been related to the concept of anxiety in any consistent way. Yet in this study a highly statistically significant difference was found in the tonic conductance levels of the two groups. This difference became significant only after subjects were further selected on a dimension of manifest anxiety. The implication is that tonic skin conductance levels may in fact be a reliable measure of chronic pathological
anxiety but that this relationship has been obscured in the past by inadequate selection of subjects comprising experimental and control groups. If this is the case tonic skin conductance levels would provide a physiological measure with which to assess the effectiveness of different techniques in reducing chronic pathological anxiety.
Based on the finding that anxiety patients manifest higher levels of tonic skin conductance than controls, the conclusion that chronic pathological anxiety is a state of overarousal seems warranted. More tenuous conclusions emanating from the group differences in heteromodally produced phasic change are that anxiety patients are chronically overaroused as reflected in tonic conductance levels as a function of an inability to produce psychologically mediated inhibitory responses and thus to effectively modulate arousal. Because of this inability they must rely on a more basic line of defense against further overarousal as reflected in their responses to increasing heteromodal stimulation, i.e., a reflexive physiologically mediated regulatory mechanism that keeps the system within homeostatic limits. This inability to psychologically modulate responsivity to incoming data was also reflected in the anxiety patients' inability to discriminate light levels in the face of interfering noise stimulation as well as did normals. This conclusion must be considered tenuous because no direct evidence that normals in fact did produce psychologically mediated inhibitory responses was found but rather is inferred, and because it is possible that the cognitive deficit manifested by anxiety patients can be interpreted as caused by overarousal rather than
the reverse.
References

Alexander, R. Personal communication, 1975.


Jurko, M., Jost, H., & Hill, T. S. Pathology of the energy system: An experimental-clinical study of physiological adaptive capacities in a non-patient, a psychoneurotic, and an early paranoid schizophrenic group. J. Psychol.,
1952, 33, 183-198.


Malmo, R. B. Studies of anxiety: Some clinical origins of


McReynolds, P., Acker, M., & Brackbill, G. On the assessment


Venables, P. H. Some findings on the relationship between
GSR and motor task variables. J. Gen. Psychol., 1956, 55, 199.


APPENDICES
APPENDIX A

Information about "Chronic Anxiety as an Inability to Inhibit Arousal"

The purpose of this study is to look into possible differences between people who suffer from anxiety that is strong or chronic enough to present problems in that person's life, and people who do not. In particular, prior research has suggested that people who suffer from chronic anxiety show different patterns of physiological arousal in reaction to stimulation. Some research at the University of Massachusetts suggests that while most people inhibit arousal when stimulation becomes intense, people who are anxious do not. This study is designed to look more closely at this phenomena both because it is worthwhile just to know what the differences are, and knowing the differences may lead to better therapeutic techniques for dealing with anxiety.

The procedure is simple, straightforward and nonaversive, that is, not painful. After filling out a brief questionnaire, you will sit in a chair in a sound and light dampened room facing a HiFi speaker and a reflective box. Electrodes will be attached to two of your fingers and one ear. These will measure your physiological responses to the stimulation. These electrodes cannot shock you or hurt you in any way. They merely pick up physiological changes that happen in you and record them on paper. You are welcome to see this re-
cording after the experiment.

Every 45 seconds you will be presented with a simultaneous flash of light and burst of noise that lasts 1/10 of a second and varies in intensity. Each presentation will be proceeded by a 3-second warning light. The brightest light is not nearly as intense as a flash bulb used in photography and the highest sound is much less intense than what you would hear at a dance or rock concert. After each presentation I will ask you to rate how much you were startled by the light and noise. That's it. There is nothing tricky or painful about the experiment. It will last about one hour.

If you consent you will earn five dollars. You are free to stop at any point during the experiment if for some reason you change your mind. Feel free to ask any questions. Also, I would appreciate any reactions or thoughts you have about the procedure once we are done. Thanks for your cooperation.

David Smith
AUTHORIZATION FOR PATIENT PARTICIPATION IN A RESEARCH STUDY

Date and Place of Signing:

________________________________________________________________________

1. I hereby consent to participation ___________________________ (Name of Patient)

   in the investigation, "Chronic anxiety as an inability to inhibit arousal".

2. The purpose of the study and the risks involved have been explained to me. I acknowledge that no guarantee or assurance has been made as to the results that may be obtained.

   Patient ___________________________ (Signature)

   When patient is incompetent to affix signature:

   Person authorized to consent for patient ___________________________ (Signature)

   (Address)

   Authority to consent ___________________________

WITNESS:

 ___________________________ (Signature) (Address) (City and State)

Patient's identification (For typed or written entires give: Name - last - first, middle; date, hospital or medical facility)
APPENDIX B(1)

Frequency of Feelings Questionnaire

These adjectives describe feelings that most people experience at one time or another. Estimate how often you feel the way described, using the frequency scale below. Mark your answers using a soft pencil on the IBM form.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>almost never</td>
<td>seldom</td>
<td>sometimes</td>
<td>often</td>
<td>almost always</td>
</tr>
</tbody>
</table>

How often do you feel:

1. vigorous
2. unafraid
3. calm
4. exhausted
5. confused

6. extroverted
7. on-edge
8. jittery
9. unsettled
10. nervous

11. alert
12. pleased-with-self
13. tired
14. tense
15. disliked

16. unworthy
17. sluggish
18. scared
19. energetic
20. worried

21. unexcitable
22. enthusiastic
23. lively
24. weary
25. fatigued

26. capable
27. clear-minded
28. excited
29. incompetent
30. shy

31. all-together
32. secure
33. dazed
34. fragmented
35. worthy

36. bewildered
37. restless
38. spontaneous
39. organized
40. relaxed

41. lovable
42. disorganized
43. annoyed-with-self
For the following statements indicate how true each is for you, using the scale below:

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Tend to Disagree</th>
<th>Undecided</th>
<th>Tend to Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

44. I sometimes have feelings of anxiety for no special reason.
45. I usually act on the spur of the moment.

46. I am often awakened at night by small noises.
47. I am fairly good at adapting to new situations.
48. I am usually able to snap into alertness within a minute of waking.
49. I am troubled by a nervous stomach.
50. I feel right at home at a lively, talkative party.

51. I can't concentrate unless I have complete peace and quiet.
52. I have a high opinion of myself.
53. I usually need an hour to become fully awake in the morning.
54. I often have trouble figuring out what I should do, or what I want to do.
55. I sometimes notice my heart pounding wildly for no good reason.

56. I am startled more easily than most people by sudden suprises.
57. I often feel disorganized and confused.
58. I am able to concentrate even when others around me are talking.
59. I make friends easily.
60. When I start laughing it seems that I can't stop myself.

61. I break out in a nervous sweat.
62. Photographic flashbulbs seem to startle me less than most people.
63. I like lots of stimulation.
64. If people saw who I really am, they wouldn't think well of me.
65. I have a startle response when a telephone rings.

66. My sleep is fitful and disturbed.
67. I almost always enjoy meeting people.
68. I am usually capable of making clearly thought-out decisions.
69. I find it difficult to prevent myself from crying when badly upset.
70. I am an impulsive person.

71. When studying I am easily distracted by things happening around me.
72. I usually feel fairly put together and on top of things.
73. At times I have fits of laughing or crying that I cannot control.
74. I feel like beating or smashing things.
75. When reading, I can ignore a radio or TV in the room with me.

76. At night I usually fall asleep in a minute or less.
77. I sweat easily even on cool days.
78. I start to work on a new project with a great deal of enthusiasm.
79. I am a nervous person.
80. I feel good about myself, who I am and what I'm like.

81. Sometimes I like in bed for hours before falling asleep.
82. I am more easily startled by sudden flashes of light than most people.
83. I often feel depressed.
84. I do not like being in completely new situations.
85. I am less startled by sudden noises than most people.

86. I seem to lack the drive necessary to get a lot of work done.
87. I frequently play with my lips and teeth.
88. I am an active, person, on the go all day long.
89. When I work I am able to ignore almost any distraction.
90. I feel that I am about to go to pieces.

91. I have little respect for myself.
92. I am a heavy sleeper, not easily awakened by noises at night.
93. I often feel the urge to stir up excitement.
94. I do not startle easily.
95. I tend to fall apart under stress.

96. I can sleep through almost any commotion.
97. I need absolute quiet when studying.
I often feel disorganized and confused.

For the following statements try and decide whether Yes or No represents your usual way of acting or feeling. We want your first reaction so work quickly.

1 = NO  
2 = YES

99. Do you often long for excitement?
100. Do you often need understanding friends to cheer you up?

101. Are you usually carefree?
102. Do you find it very hard to take no for an answer?
103. Do you stop and think things over before doing anything?
104. If you say you will do something do you always keep your promise?
105. Does your mood often go up and down?

106. Do you generally do and say things quickly without stopping to think?
107. Do you ever feel "just miserable" for no good reason?
108. Would you do almost anything for a dare?
109. Do you suddenly feel shy when you want to talk to an attractive stranger?
110. Once in a while do you lose your temper and get angry?

111. Do you often do things on the spur of the moment?
112. Do you often worry about things you should not have done or said?
113. Generally do you prefer reading to meeting people?
114. Are your feelings rather easily hurt?
115. Do you like going out a lot?

116. Do you occasionally have thoughts and idea that you would not like other people to know about?
117. Are you sometimes bubbling over with energy and sometimes very sluggish?
118. Do you prefer to have few but special friends?
119. Do you daydream a lot?
120. When people shout at you, do you shout back?

121. Are you often troubled about feelings of guilt?
122. Are all your habits good and desirable ones?
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>123. Can you usually let yourself go and enjoy yourself a lot at a lively party?</td>
<td></td>
</tr>
<tr>
<td>124. Would you call yourself tense or &quot;highly-strung&quot;?</td>
<td></td>
</tr>
<tr>
<td>125. Do other people think of you as being very lively?</td>
<td></td>
</tr>
<tr>
<td>126. After you have done something important, do you often come away feeling you could have done better?</td>
<td></td>
</tr>
<tr>
<td>127. Are you mostly quiet when you are with other people?</td>
<td></td>
</tr>
<tr>
<td>128. Do you sometimes gossip?</td>
<td></td>
</tr>
<tr>
<td>129. Do ideas run through your head so that you cannot sleep?</td>
<td></td>
</tr>
<tr>
<td>130. If there is something you want to know about, would you rather look it up in a book than talk to someone about it?</td>
<td></td>
</tr>
<tr>
<td>131. Do you get palpitations or thumping in your heart?</td>
<td></td>
</tr>
<tr>
<td>132. Do you like the kind of work that you need to pay close attention to?</td>
<td></td>
</tr>
<tr>
<td>133. Do you get attacks of shaking or trembling?</td>
<td></td>
</tr>
<tr>
<td>134. Would you always declare everything at the customs even if you knew that you could never be found out?</td>
<td></td>
</tr>
<tr>
<td>135. Do you hate being with a crowd who play jokes on one another?</td>
<td></td>
</tr>
<tr>
<td>136. Are you an irritable person?</td>
<td></td>
</tr>
<tr>
<td>137. Do you like doing things in which you have to act quickly?</td>
<td></td>
</tr>
<tr>
<td>138. Do you worry about awful things that might happen?</td>
<td></td>
</tr>
<tr>
<td>139. Are you slow and unhurried in the way you move?</td>
<td></td>
</tr>
<tr>
<td>140. Have you ever been late for an appointment or work?</td>
<td></td>
</tr>
<tr>
<td>141. Do you have many nightmares?</td>
<td></td>
</tr>
<tr>
<td>142. Do you like talking to people so much that you would never miss a chance of talking to a stranger?</td>
<td></td>
</tr>
<tr>
<td>143. Are you troubled by aches and pains?</td>
<td></td>
</tr>
<tr>
<td>144. Would you be very unhappy if you could not see lots of people most of the time?</td>
<td></td>
</tr>
<tr>
<td>145. Would you call yourself a nervous person?</td>
<td></td>
</tr>
<tr>
<td>146. Of all the people you know, are there some whom you definitely do not like?</td>
<td></td>
</tr>
<tr>
<td>147. Would you say you were fairly self-confident?</td>
<td></td>
</tr>
<tr>
<td>148. Are you easily hurt when people find fault with you or your work?</td>
<td></td>
</tr>
<tr>
<td>149. Do you find it hard to really enjoy yourself at a lively party?</td>
<td></td>
</tr>
</tbody>
</table>
150. Are you troubled with feelings of inferiority?

151. Can you easily get some life into a rather dull party?
152. Do you sometimes talk about things you know nothing about?
153. Do you worry about your health?
154. Do you like playing pranks on others?
155. Do you suffer from sleeplessness?
Appendix B(2)
Scale Items with Valences

<table>
<thead>
<tr>
<th>Manifest Anxiety</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>+49</td>
<td>+79</td>
</tr>
<tr>
<td>-3</td>
<td>+53</td>
<td>+81</td>
</tr>
<tr>
<td>+8</td>
<td>+55</td>
<td>+83</td>
</tr>
<tr>
<td>+14</td>
<td>+56</td>
<td>+87</td>
</tr>
<tr>
<td>+20</td>
<td>+61</td>
<td>+90</td>
</tr>
<tr>
<td>-32</td>
<td>+65</td>
<td>-94</td>
</tr>
<tr>
<td>+37</td>
<td>+73</td>
<td>+95</td>
</tr>
<tr>
<td>-40</td>
<td>+74</td>
<td>+98</td>
</tr>
<tr>
<td>+44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pleasant Excitement</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>+1</td>
<td>+23</td>
<td>+63</td>
</tr>
<tr>
<td>+6</td>
<td>+28</td>
<td>+67</td>
</tr>
<tr>
<td>+11</td>
<td>+38</td>
<td>+70</td>
</tr>
<tr>
<td>+19</td>
<td>+45</td>
<td>+88</td>
</tr>
<tr>
<td>-21</td>
<td>+50</td>
<td>+93</td>
</tr>
<tr>
<td>+22</td>
<td>+59</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fatigue</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>+4</td>
<td>+17</td>
<td>+25</td>
</tr>
<tr>
<td>+13</td>
<td>+24</td>
<td>+33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Self Esteem</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>+12</td>
<td>-29</td>
<td>+52</td>
</tr>
<tr>
<td>-15</td>
<td>+35</td>
<td>-64</td>
</tr>
<tr>
<td>-16</td>
<td>+41</td>
<td>+80</td>
</tr>
<tr>
<td>+26</td>
<td>-43</td>
<td>-91</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cognitive Integraty</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-5</td>
<td>+39</td>
<td>-57</td>
</tr>
<tr>
<td>+27</td>
<td>-42</td>
<td>+68</td>
</tr>
<tr>
<td>+31</td>
<td>+47</td>
<td>+72</td>
</tr>
<tr>
<td>-36</td>
<td>-54</td>
<td>-84</td>
</tr>
</tbody>
</table>
Appendix C(1)

Ratings of Emotions

Describe your emotional state right now by musing the following scales.

Circle the appropriate number.

(9) 1. frightened, worried, threatened
(7) 2. happy, cheerful, joyous
(4) 3. angry, irritated, annoyed
4. warm-hearted, kindly, affectionate
(11) 5. energetic, aroused, alert
6. self-accepting, good attitude toward self, warm feelings toward self
7. unhappy, sad, gloomy
(18) 8. frustrated, blocked, inhibited
9. secure, unafraid, unthreatened
(16) 10. unworthy, inadequate, displeased with self
11. tired, weary, unreactive
(15) 12. powerful, strong, in command of one's fate
(19) 13. tense, jittery, nervous
(17) 14. clear minded, integrated, in harmony with self
15. powerless, weak, helpless
16. worthy, adequate, pleased with self
17. confused, disorganized, fragmented
18. free, unrestrained, spontaneous
19. calm, relaxed, at ease

not at all 1 2 3 4 very 5

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
Appendix C(2)
Ratings of Emotions

This time describe your usual emotional state. How often do you have the following feelings?

Again circle the appropriate number

<table>
<thead>
<tr>
<th>Feeling</th>
<th>never</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. frightened, worried, threatened</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. happy, cheerful, joyous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. angry, irritated, annoyed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. warm-hearted, kindly, affectionate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. energetic, aroused, alert</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. self-accepting, good attitude toward self, warm feelings toward self</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. unhappy, sad, gloomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. frustrated, blocked, inhibited</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. secure, unafraid, unthreatened</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. unworthy, inadequate, displeased with self</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. tired, weary, unreactive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. powerful, strong, in command of one's fate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. tense, jittery, nervous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. clear-minded, integrated, in harmony with self</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. powerless, weak, helpless</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. worthy, adequate, pleased with self</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. confused, disorganized, fragmented</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
18. free, unrestrained, spontaneous  1  2  3  4  5
19. calm, relaxed, at ease  1  2  3  4  5