PATTERNS OF CARDIAC AROUSAL IN THE CLASSROOM DETERMINED

BY TELEMETRY DURING RESPONSE TO SPEECH MESSAGES

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DISSERTATION

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CHAPTER I

INTRODUCTION

According to arousal theory the rate of learning is related to the arousal or activation level of the individual. Learning may be inefficient because the arousal level is either too high or too low. Activation simultaneously produces concomitant changes in a number of other physiological indices such as heart rate, respiration, skin conductance and muscle tension. These have been measured and studied under a variety of circumstances and learning conditions. The measurement values indicate the drive level, and where students are concerned, the measures may provide clues to possible courses of action in the teacher-learning process.

It has been shown that the efficiency of complex mental activity is characterized by heightened arousal. Furthermore, situations having a high degree of significance for the individual will, if other factors are constant, produce a high degree of arousal, while the converse is true for those situations with a low degree of significance (20).

Despite considerable research devoted to autonomic arousal during behavioral performance, the literature is practically void of such studies involving students in actual classroom situations. Since the arousal level may be changed by changing the amount of stimulation provided by the environment, research is needed to determine possible relationships among events and activity in the classroom, autonomic arousal and mental performance. The present investigation was an attempt to explore the relationship between selected classroom activities and cardiac arousal.

Statement of the Problem

The problem of this study was the effect of speech messages on the cardiac rate of students in the classroom.

Purposes of the Study

The purposes of this study were (1) to determine the relationship between recitation in the classroom and changes in the cardiac rate, (2) to determine the effects on cardiac rate of anticipation of recitation and tests, (3) to determine the effects on cardiac rate of compliments and assurance directed toward students by the teacher, and (4) to determine the effects on the cardiac rate of verbal threats and ridicule.

Hypotheses

To carry out the purposes of this study, the following hypotheses were formulated:

1. There will be a significant difference found in the mean cardiac rates of students receiving unanticipated speech messages from the teacher compared to those receiving anticipated messages.

2. There will be a significant difference found in the mean cardiac rates of students doing extemporaneous or impromptu recitation without anticipation compared to those reciting extemporaneously with expectation.

3. There will be a significant difference found in the mean cardiac rates of non-anticipatory students with respect to recitation while receiving compliments and assurance from the teacher compared to anticipatory students.

4. There will be a significant difference found in the mean cardiac rates of non-anticipatory students with respect to recitation while receiving verbal threats and ridicule from the teacher compared to anticipatory students.

5. There will be a significant difference found in the mean cardiac rates of students taking an unannounced test without anticipation compared to those taking the test with expectation.

6. Anticipatory and non-anticipatory students will exhibit a significant difference in level of cardiac rate between the classroom occasions of initial rest, message reception, reciting, receiving compliments, receiving ridicule, and taking a test.

7. Students engaged in presenting oral reports will experience a significantly greater mean cardiac rate than when engaged in impromptu recitation.

Background and Significance of the Study

The study of physiological psychology has added much to the understanding of human behavior. Among the most profound and significant contributions of this discipline was the discovery and elaboration of the mechanism and function of the ascending reticular activating system (ARAS) (24, 37). The ARAS, which is also referred to as the arousal system, reticular formation or reticular system, is a completely interconnected feltwork of neurons that runs through the brain stem of the medulla and midbrain as well as the thalamus. Every sensory pathway traveling to the higher centers of the brain, as well as every descending motor pathway, sends side branches to the reticular system. The system can be regarded as receiving "wire taps" from incoming and outgoing communications channels of the brain.

The anatomical and physiological characteristics of the arousal system are developed and organized in such a way that the system performs a psychological arousal or vigilance function. It activates the rest of the brain upon receipt of stimuli. Direct stimulation of the cortex does not awaken the brain; it must be called into action by the reticular system. The system monitors all incoming stimuli, compares them with one another, and then magnifies some and suppresses others. It is an indispensable filter that lets only a few of the major inputs reach the higher center of the brain and elicit reaction. Not only does the reticular system filter out some stimuli at the level of the brain itself, but it also sends inhibitory impulses down the spinal cord to block some incoming impulses before they ever reach the brain. Impulses of the anterior cranial nerves may also be blocked. The system can do more than modify and even block incoming sensory impulses; it can similarly modify outgoing motor impulses at the level of the brain and at the level of the spinal cord, thereby increasing the magnitude of some muscular responses and decreasing that of others (24, 26).

According to the activation theory as first stated by Lindsley (37) and later elaborated by Hebb (27) and Lindsley (38), the continuum extending from deep sleep at the low activation end to "excited states" at the high activation end is very largely a function of cortical bombardment by the ARAS, such that the greater the cortical bombardment, the higher the activation. Further, the relation between activation and behavioral efficiency (cue function or level of performance) is described by an inverted U curve. That is, from low activation up to a point that is optimal for a given function, level of performance rises monotonically with increasing activation level, but beyond this optimal point the relation becomes non-monotonic; further increase in activation beyond this point produces a fall in performance level. This fall is directly related to the amount of the increase in level of activation.

In setting forth his activation theory, Lindsley (37) gives five significant points supported by experimental evidence:

> 1. The electroencephalogram (EEG) in emotion presents an "activation pattern," characterized by reduction or abolition of synchronized (alpha) rhythms and the induction of low-amplitude fast activity.
>
> 2. The activation pattern in the EEG can be reproduced by electrical stimulation of the brain-stem reticular formation extending forward into the basal diencephalon through which its influence projects to the thalamus and cortex.
>
> 3. Destruction of the basal diencephalon (i.e., the rostral end of the brain-stem activating mechanism), abolishes activation of the EEG and permits restoration of synchronized rhythmic discharges in the thalamus and cortex.

> 4. The behavioral picture associated with point three is the antithesis of emotional excitement or arousal, namely, apathy, lethargy, somnolence, catalepsy, hypokinesis, etc.
>
> 5. The mechanism of the basal diencephalon and lower brain-stem reticular formation, which discharges to motor outflows and causes the objective features of emotional expression, is either identical with or overlaps the EEG activating mechanism, described under point two, which arouses the cortex (37, p. 505).

Further support for the development of the arousal theory can be found in the early writings of Freeman (22) and Duffy (16, 18) who stressed the importance of an intensity dimension in behavior. These workers, using palmar conductance and muscular tension respectively (23, 18) as the intensity variable, concluded that there was a lawful relationship between a state of the organisms called "arousal," "energy mobilization," "activation," or simple "intensity," and level of performance. Moreover, they suggested that the relationship might be described as an inverted U curve (18).

"Activation" and "arousal" as used by Duffy (20) do not refer specifically to the activation pattern of the EEG. On the contrary, they refer to variations in the excitation of the individual as a whole, as indicated roughly by any one of a number of physiological measures. The degree of activation appears to be best indicated by a combination of measures and is defined as the extent of release of potential energy, stored in the tissues of the organism, as this is shown in activity or response.

Although the inverted U hypothesis has been attacked experimentally, with some exceptions found by several investigators (10, 29, 57), it has been shown to be valid in numerous learning and performance situations (12, 30, 36, 42, 51, 56). In addition to galvanic skin response and electrical potential from the muscles, other intensity variables used in the study of arousal and emotion include cortical and subcortical electroencephalograms (13, 37), the heart rate (15, 47, 53), grip pressure (19), eye movement (39), pilomotor response (40), gastric contraction (49, 61), blood pressure (53, 59), finger pulse volume (14, 36), respiration (53, 59), pupillary response (4), tremor (3, 25), demographia (60), salivary secretion (62), and skin temperature (43). The analysis of blood, saliva, and urine has shown that their chemical constituents may be affected by emotional stimulation (7, 26, 35, 44, 48). The evidence suggests that the former four (EEG, EMG, GSR and HR) may be maximally useful as indicants of arousal.

Any increase in arousal accompanies an increase in physiological activity. Measurement of the physiological indicants of arousal affords, when other factors are constant, a direct measure of the "motivating" or "emotional" value of the situation to the individual. Or, stated another way, the energy requirements for a particular situation are reflected physiologically, or the measured value of the physiological indices of arousal is a measure of the significance of a situation.

The cardiac rate should prove to be a worthy variable to study in the classroom since it can be determined telemetrically. It is among the more reliable autonomic measures, responds rapidly, and can be continuously recorded without drastically limiting the subject's activity and movement.

Having once established that effective behavior is eliminated during low and high arousal states (18, 20, 27), a whole new series of problems began to emerge. Especially significant to the present study are those problems involving activation levels as they relate to emotional and learning phenomena. The two main generalizations derived from the study of arousal phenomena are given by Bindra (5):
(1) There is an optimum range of level of arousal within which a given measure of performance will reach its highest (or lowest) value; the greater the deviation in either direction from the optimum arousal level, the greater will be the decrease (or increase) in the performance measure.

(2) With increase practice of performing an activity or task (i.e., with increased habit strength of a response), there is an increase in the range of the optimal level of arousal, as well as in the range within which the activity occurs at all. These two generalizations, while providing wide and diverse implications for educational practices, obviously pose numerous problems. Many concepts and problems of emotion, perceptual processes, personality, and motivational theory involve arousal and its manifestation (2, 5, 6, 18, 27, 37, 38, 43).

Not all psychologists agree on the factors or phenomena labeled emotion. Most would concur, however, that emotion is one of the most complex phenomena known to psychology and that emotional factors play an important role in all learning processes.

Emotional behavior is characterized by many combinations of bodily changes. There are overt manifestations that are readily observable such as postural orientation, facial expressions, gestures, and vocalization. But even these are not universally acceptable criteria of emotion because they are highly susceptible to cultural and social modifications, and they are admixtures of voluntary and involuntary modes of response. Because of their dynamic qualities and their relation to other bodily processes, external indications of emotion require more detailed examination than casual observation can provide. There are also organic and physiological changes that are revealed only by special procedures and recording devices. All bodily changes during emotion are dependent upon complex underlying processes that become integrated by the autonomic nervous system, the cerebrospinal system, and the endocrine system (37). The external as well as the internal manifestations of emotion may be considered as a function or consequence of physiological arousal. A cognition appropriate to the state of arousal determines the nature of the emotion (51).

The role of emotion in learning is evident when one considers as one gets older how particular emotions are aroused by different objects and situations. Further, by associating some stimulus which produces emotion with a stimulus which does not produce it, one may give emotion-provoking potency to the previously neutral stimulus and to stimuli similar to it (45). The fact that emotional reactions are shaped both by experience with the environment and by the maturational level of perceptual and intellectual capacities testifies to the complexity of the problem and to the need for continued research in emotions, values, attitudinal and physiological changes and their place in the educative process.

Relevant to the significance of this study is the phenomenon of stress. Stress may be considered as the state manifested by a specific syndrome which consists of all the non-specifically induced changes within a biologic system. It is any tension or conflict resulting from a stressor, the latter being anything producing stress (54). In defining psychological stress, Appley and Trumbull (1, p. 5) state:

> 1. On the stimulus side, the term has been used to describe situations characterized as new, intense, rapidly changing, sudden or unexpected, including (but not requiring) approach to the upper thresholds of tolerability. At the same time, stimulus deficit, absence of expected stimulation, highly persistent stimulation, and fatigue-producing and boredom-producing settings, among others, have also been described as stressful, as have stimuli leading to cognitive misperception, stimuli susceptible to hallucination, and stimuli calling for conflicting responses. Any one of these procedures has at some time actually been used as an operational means for defining and producing stress.
>
> 2. On the response side, the presence of emotional activity has been used post facto to define the existence of stress. This usually refers to any bodily response in excess of "normal or usual"--states of anxiety, tension, and upset--or for that matter any behavior which deviates momentarily or over time from normative value for the individual in question or for an appropriate reference group. Indices used include such overt emotional responses as tremors, stuttering, exaggerated speech characteristics, and loss of sphincter control--or such performance shifts as perseverative behaviors, increased reaction time, erratic performance rates, malcoordination, error increase, and fatigue.
>
> 3. The existence of a stress state within the organism has alternatively been inferred from one or more of a number of partially correlated indices, such as a change in blood eosinophils, an increase in 17-ketosteroids in the urine, an increase in ACTH-content of gluco-corticoid concentration in the blood, or changes in any

> number of psychophysiological variables, such as heart-rate, galvanic skin response (GSR), change in critical flicker fusion (CFF) threshold, inspiration: expiration $\frac{I}{E}$ ratio, and so on. (These are response measures, of course, but they can be usefully distinguished from responses which are of the order of overt performance changes or observable symptoms of emotionality, such as those noted above.)

Similar connotations for psychological stress are given by Horvath (28). Cofer and Appley (11) define stress as "the state of the organism where he perceives that his well-being (or integrity) is endangered, and that he must divert all his energies to its protection" (11, p. 453). In all of these instances there is an emphasis on individual determination of when stress will or will not occur. It is assumed that in the teacher-learning situation there exists, at times, a certain amount or degree of stress and anxiety. There is relatively little disagreement that for some students reciting or taking an examination is a very frustrating experience. According to Ruch (50), when an individual is motivated to achieve a certain level of proficiency in performing a task, failure or threat of failure produces stress. Working under the pressure of time or under distracting conditions also induces stress in the learner. Studies by Lazarus and Erickson (34) show that individual differences are extremely important in determining just how stress influences learning. There is evidence that stress may help performance when an existing response is to be strengthened but impede it when a new response is to be substituted for an old one. Castaneda and Lepsitt (9) point out that stress, like punishment, seems to have less disturbing effects late in learning than during the early stages.

The dynamics of stress evidently involve a complex relation between strength of motivation, degree of frustration, and personality factors. In some cases and under some conditions, threat of failure seems to motivate the learner strongly to work for success, thereby facilitating performance. In other cases, however, the emotional components of stress seem to be so disturbing that they disrupt performance, producing "mental blocks" or severe anxiety reactions which distract the learner from his task (50). According to Arnold (2), stress results in emotion, but emotion can also produce stress. At any rate, behavior may be modified by stress and the problem of the role stress play in learning is far from being resolved (28, 33, 52).

In the present study, the determination of cardiac activity of students during response to the teacher's speech message is largely a measurement of the amount of stress experienced by the student which is evoked by the teacher. This kind of research has not been undertaken. If it could be established that certain classroom events evoke specific levels of stress or arousal, then, the next step would be to determine the arousal level where mental performance or learning is best achieved.

As Malmo (41) points out, the three main lines of approach to the problem of activation have been (a) through electroencephalography and neurophysiology, (b) through studies of behavioral energetics, and (c) through the learning theorists' search for a satisfactory measure of drive. Hebb (27) and Malmo (41) propose to treat arousal as synonymous with a general drive state. They point out, however, that activation, to be distinguished from vitality, is without direction. It is one of the two effects of a sensory event, the other effect being cue function or guiding behavior which is dependent upon arousal. This means that efficient learning or functioning is only possible when the arousal level is high. The pressing questions, then, involve those psychological, sociological and physiological factors which relate to various degrees of arousal. Although some research has been conducted in these directions (15, 21, 37, 36, 56), many of the problems remain unresolved. This research considers some aspects of the arousal phenomena within the category of psychophysiology and should elucidate the relationship of a unique psycho-social event (e.g., recitation in the classroom) and cardiac arousal.

In discussing motivational phenomena, Bindra (5) refused to recognize any distinction between the traditional categories of emotional behavior and motivated behavior. This view is supported by Arnold (2) and Duffy (17). Cofer (10) suggested more than a decade ago that motivation was on its way to integration with the activation theory. He noted that many behavioral phenomena, ordinarily termed emotional or motivational, can best be interpreted as stemming instead from the level or degree of activation, arousal, excitation or energy mobilization of the organism. Kendler (29) notes that the Jerkes-Dodson hypothesis is also related to arousal or activation formulations in that both assume that differences in activation are accompanied by difference in performance.

Research is needed to further define arousal, emotion, motivation, and related phenomena as these may indeed have a closer interrelationship than is presently suspected.

The role of the reticular formation in arousal is well established (24, 38). More recently the limbic system has been assigned the role of controlling incentive-motivational behavior (49).

The fact that behavior has direction and intensity has broad implications. The intensity component with which this study is primarily concerned may be measured by two methods: force of overt action and changes in internal processes (20). The problems indicated above are further compounded by the fact that physiological indicants of arousal lack consistency from individual to individual and from one situation to the next. However, the research findings by Schnore (53), Freeman (21), Lacy (31, 32), and Duffy (17) suggest that although individuals will indeed exhibit idiosyncratic patterns of physiological activation, these patterns will be consistent for the individual in qualitatively different situations and in those designed to be differentially arousing. The research presented here should support this hypothesis.

Interpersonal interaction between two or more individuals has been long assumed to evoke physiological as well as psychological consequence among all participants in a group. The cardiac rates of students during recitation and other classroom events should reflect the degree of significance of the situation as required by the arousal hypothesis and provide some basis for evaluating stimulus sources.

This kind of study assumes further significance in that it will be an attempt to understand people just as they are in the situation in which teachers must deal with them.

Definition of Terms

For the purpose of this study the following definitions have been formulated:

Arousal--Cardiac arousal or activation as used in this study is defined in terms of measures, the cardiac rate, obtained by cardiotachometry telemetrically.

Cardiac rate--The heart rate (HR) measured in beats per minute is defined as the physiological indicant of arousal.

Recitation--Any verbal response by the student to the teacher's question or directions in the classroom is defined as a recitation.

Classroom activity--*event* and *occasion*--These terms are used interchangeably to refer to any behavior carried on by the subject, other students, and teacher while in the classroom.

Initial rest--In the classroom the occasion preceding the subject's message reception from the teacher is defined as initial rest.

Speech message--Any verbal question or directions given to the subject by the teacher in the classroom is defined as a speech message.

Rest--In the classroom the occasion following recitation or test taken by the subject is defined as the rest period.

Anticipatory subjects--Those subjects who were told that they would be called upon to recite in class or told that a test would be given are defined as anticipatory subjects.

Non-anticipatory subjects--Those subjects who were told that they would not be called upon to recite in class but in fact were and told that a test would not be given when in fact it was given are defined as non-anticipatory subjects.

Verbal compliments and assurance--Any complimentary remark directed toward the subject by the teacher in the classroom regarding his performance quality is defined as the occasion of compliment and assurance (Appendix B).

Verbal threats and ridicule--Any derogatory or threatening remarks by the teacher in the classroom regarding the quality of the class performance is defined as ridicule or a threatening occasion (Appendix B).

Limitations of the Study

This study was limited to cardiac activity and selected classroom events. No attempt was made to control student and teacher emotions, personality, physical attributes, physiological properties, and the general interpersonal interaction and communication among student and teacher because such an attempt would introduce artificiality in the normal classroom setting. Also, no attempt was made to relate cardiac activity to learning.

Basic Assumptions

While there were factors other than those studied which relate to cardiac arousal, they did not negate the significance of determining quantitative changes in the cardiac rate during a specific classroom event.

It was further assumed that the subjects involved in the study and other class members were equally exposed to the general psychological and sociological factors prevailing in the classroom.

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CHAPTER II

REVIEW OF RELATED LITERATURE

As with other autonomic indices of arousal, cardiac responses during behavioral performance have been studied under a variety of circumstances. Blatz (11), Cannon (15), Beebe-Center and Stevens (6), Armstrong (3), and Hickam et al. (34) were among the early investigators to demonstrate concomitant pulse rate changes with alterations in emotional behavior. Physiological measurements made by Jost (41) during periods of attention, learning, frustration, recall, and sensory stimulation showed that the heart rate accelerated during these periods in two different groups but declined slower following frustration in subjects with adjustive problems. Berg and Beebe-Center (7) have shown that the cardiac startle response in man becomes habituated by successive gun-shot sounds and that the response may be disinhibited by the interpolation of either a different stimulus or a lapse of time. Early work by Darrow (20), Shock and Schlatter (80) provide evidence suggesting that associative processes or ideas are more effective in increasing cardiac rate than momentary sensory stimuli. With some exceptions, the latter are more effective in altering GSR, EMG, and vasoconstriction.

The above research, mostly conducted more than three decades ago, helped to set the stage for later and modern attacks on the problems evolved from arousal theory. Malmo and Davis (60) measured EMG, HR, and BP while subjects were doing mirror tracing. The physiological measures were found to be reliably correlated with the speed of performance. Similar results were obtained by Schnore (77) while subjects were doing arithmetic and visual-pursuit-tracking. Malmo (59) later reports that physiological gradients accompanying mental activity do not necessarily signify increasing cortical arousal during the behavioral sequence (e.g., task or period of attentive listening). He reports that cortical activity may remain relatively constant during the sequence when skeletal-motor and cardio-respiratory levels show progressive rise and suggest that the gradients do not represent increasing motivation during a task, but that the steepness of the gradients is a function of the motivational level. Neva *et al*. (65) have used GSR and HR to show an increasing monotonic function between induced muscle tension and physiological activity.

Blatt (10) obtained concurrent recordings of cardiac rate as subjects attempted to solve problems on the John-Rimoldi

Problem Solving Apparatus (PSI). Compared to inefficient subjects, the results showed a highly significant increase in cardiac rate and variability in efficient subjects while they were attempting to solve the problems. Moreover, the elevations of cardiac rate of efficient subjects occurred at crucial moments in the thought process: where necessary and sufficient information for solution was available, where the subject's predominant activity changed from analysis to synthesis, and at solution. Similar results are reported by Obrist et al. (69) from their studies of autonomic levels and liability, and performance time on a perceptual task and a sensory motor task. They found faster performance time on the sensory motor task with subjects having a low resting heart rate and increased heart rate variability during performance.

In a study by Kaufman et al. (44), twenty-seven subjects performed for two difficulty levels of a Lacy "silent elaboration" type mental task against three auditory background conditions. The findings support the suggestion that cardiovascular augmentation serves to sustain attention level appropriate to solution of a given task and that more difficult mental work will elicit less cardiac supplementation than easy mental work. Experiments by Edwards and Alsip (28) failed to confirm Lacy's contentions that elevated heart rate and blood pressure could lead to decreased sensory sensitivity and that a reduction in HR and blood pressure may facilitate sensory sensitivity.

Craig _et al_. (19) studied subjects deprived of sleep for sixty hours. During the night before and during the night after deprivation, simultaneous recordings of HR and skin conductance were taken. When the night before deprivation was compared to the night after deprivation, HR was found to be significantly higher, while skin conductance tended to be lower, interacting significantly with time.

In studying the habituation of the orienting response in alert and drowsy subjects, McDonald _et al_. (58) found no significant habituation of the HR response in the drowsy group, but rather an increase in the level of HR over trials (ten presentations of a buzzer of three-seconds duration with inter-trial intervals varying from thirty to sixty seconds). The mean cardiac response of the drowsy group was also significantly greater than that of the alert group. Similar results are reported by Malmo and Survillo (61). Their measurements of several autonomic responses during tracking indicated that drowsiness (sleep deprivation) had the effect of increasing the level of activation.

Research results reported by Dykeman _et al_. (27) support the earlier findings by Darrow (20). The HR of their subjects increased significantly greater during an emotional and non-emotional questioning period of eleven minutes than during a tone period. These investigators also reported that the overall difference in autonomic responses to novel stimuli between subjects high in anxiety and low in anxiety was not significant by statistical tests. The latter conclusion, with some exceptions, was also drawn from research conducted by Lewinsohn (53), Hodges and Spielberger (37).

Autonomic responses including HR during states of fear and anger have been recorded by Ax (5). Accordingly, the intercorrelations of the physiological variables were significantly higher for anger than for fear, which was interpreted as indicating greater integration during anger. Studies of heart rate responses during experimentally-induced anxiety have been conducted by Notterman _et al_. (66), Deane and Zeaman (23), and Deane (22). In the latter case, four groups were told to expect a mild electric shock upon the appearance of a specific number within a series. Only two of the group actually received the shock. In all groups there was an acceleration in cardiac rate on the first shock anticipation trial. This acceleration was not a transitory effect which disappeared soon after the initial warning of forthcoming shock although the two groups that received shock did not retain as much of the acceleration as did the two groups not receiving shock. The groups that were told when to expect the shock showed in addition a pronounced deceleration at the time shock was expected. Both acceleration and deceleration occurred in the group that never received a shock. The author speculated that these two cardiac effects may be unlearned responses associated with what might be called anxiety and fear. When the subject expects a noxious stimulus of unknown strength, a state of anxiety with its associated response of cardiac acceleration is aroused, and in addition, if subjects expect the noxious stimulus at a particular instant in time, a state of fear with its associated response of cardiac deceleration is aroused immediately prior to and during the time the stimulus is expected. Kanfer (43) obtained similar results while studying the effects of a signal preceding an electric shock on the rate of continuous verbal responding and on HR of college students throughout a fifty-two minute period. Thackray and Pearson (82) studied the effects of threat of shock on heart rate and motor performance on a conventional pursuit rotor. One-third were told that shock would be administered if performance fell below training levels; one-third were told that shock would be randomly administered; and the remaining third served as controls. No shocks were actually administered. The group showing high fear of shock revealed significantly greater HR acceleration and performance impairment, but only under the condition in which the subjects were told that receipt of shock would be contingent on prior performance levels. Campos and Johnson (14) have shown that verbalization instruction produced a highly significant effect on HR while a variable of visual attention produced no significant effect. Apparently, with some exceptions, sensory stimuli involving continuous environmental input decelerates heart rate whereas noxious stimuli and a conceptual task result in heart rate acceleration (68, 49, 13). A diphasic pattern of change to simple auditory stimuli has been more commonly observed with adults than any other form of HR response (64).

Roessler *et al*. have pointed out the considerable controversy regarding the nature of the heart rate response. Their data (from eighteen subjects, five intensities of sound, and five intensities of light) showed significant acceleration to sound within the first five beats after stimulus onset but no significant deceleration. There were no differences between testing and differing experimental contexts. No habituation occurred and no consistent relationship between HR response and ego strength was found. Neither was there any significant HR response to light stimulation.

In studying pulse rate and other autonomic responses in relation to simple stimuli, Davis et al. (21) showed that there is a common type of circulatory response in which many aspects of the cardiovascular system are affected by peripheral vasoconstriction. These investigators observed greater changes in cardiovascular responses due to stimulus repetition than those produced with different stimulus intensities.

Chase and Graham (16) found that the heart-rate response to onset of eighteen-second, non-signal tones heard over seventy-one db white noise was solely decelerative and habituated rapidly. The response to tone offset was similar to the onset response. This was taken as evidence that cardiac deceleration is a component of the orienting reflex. The same phenomena has been observed in infants (54) and first-grade children (42). Similar heart rate responses have been recorded from animals (9, 55, 78, 88). A shift from acceleration to deceleration was also found by Thetford et al. (83) using a 1000-cycle, 100 db tone simultaneous with presenting letters in a tachistoscope. Uno and Grings (84) reported that HR changes were primarily monophasic during response to two-second burst of white noise.

Chase et al. (17) carried out two experiments wherein the cardiac rate changes were examined during the four-second fore-period of a reaction time task involving either exercise or the traditional button-push response. Three components of the heart rate response were identified: (a) an initial deceleration to the "ready" signal, (b) an intermediate component which stabilized below prestimulus level in anticipation of a button-push but accelerated in anticipation of exercise, and (c) a deceleration immediately preceding the "go" signal. The initial deceleration appeared to be an unconditioned orienting reflex to the "ready" signal and the deceleration preceding the "go" signal, a conditional "attention" response. These results suggest that two factors determine cardiac response: energy requirement and stimulus reception requirements.

Gibson and Hall (31) reported that performance of mental tasks under noise conditions resulted in significantly greater heart rate acceleration than performance under no noise conditions. Costello and Hall (18) reported that 90 db white noise in the absence of mental tasks did not produce a significant increase in the heart rate of subjects. Graham and Clifton (32) view deceleration as a component of the orienting response and acceleration as part of the defensive reflex. This interpretation is corroborated by data collected by Lacy *et al.*(47). They view deceleration as part of attending to the external environment while acceleration is part of shutting out the environment.

The diphasic cardiac responses may be viewed, on the basis of other behavioral observations (47, 70) and neurophysiological considerations (46), as part of an "attention" process which enhances stimulus reception. This interpretation is consistent with Sokolov's theory of perception (81) which maintains that the autonomic nervous system participates in the orienting reflex and that the orienting reflex facilitates perception. The "attention" theory gains further support from Germana and Klein (30) and Graham and Clifton's (32) data which show that the heart rate deceleration is a component of the orienting reflex.

In stress research, increasing emphasis has been placed on the importance of the subject's appraisal of a stress situation as a significant determinant of behavioral and physiological response to the stressor (50, 40). Much evidence is mounting which suggest that indeed different emotional responses are associated with different physiological response patterns (76).

Sadler *et al*. (75) showed that when a cognitive task was imposed during an ongoing response to cold pressor, there is a diminution in sympathetic activity. The alerting signals (i.e., taps on the arm from behind subjects) caused moderate but transient indications of sympathetic activation, but silently reading or listening to a passage induced significantly greater increases. As the HR and RR increased the variability of both decreased. Their results suggest that when a non-painful stimulus is combined with a painful one in such a way that the subject is actively responding physiologically to both, their effects are not additive. Rather, the stimuli interact in such a way that the net response is lowered below the maximum possible for the stronger stimulus or at least that sympathetic activity is held at the level induced by the stronger stimulus alone. This suggests that the competition occurs at a level below that of cognition.

An association between cardiac variability, perceptual responses, and the personality trait impulsivity has been demonstrated by Levy and Lang (52). Docter *et al*. (25, 24) studied spontaneous heart rate changes and spontaneous GSR fluctuations and compared them with motor performance on a task said to measure motor impulsivity in two identical experiments. The conclusion drawn from the experiment was that neither of the physiological measures related significantly to impulsive performance. This was true for both a complex motor task and for simple reaction time performance.

Autonomic responses and frustration-aggression studies have been made by Johanson and Shetler (39), and Hokanson and Burgess (38). Their methodological approach involves measuring subject's physiological arousal level before and after frustration and following the expression of aggression. They have found that goal-blocking and ego-threat frustration increase physiological arousal level (defined in terms of HR and systolic blood pressure) in college sophomores and that appropriately vectored direct verbal or physical aggression against an equal-status frustrator decreases post-frustration physiological arousal level. Their results indicate that "cathartic" effects (post-frustration physiological arousal level decrease) are dependent on at least three parameters: the frustrator's status, the type of aggression, and the target of aggression. Similar findings are reported from depressed psychiatric patients by Burgess *et al.* (12). Their results demonstrated that no frustration is associated with larger increases in mean heart rate and systolic blood pressure than frustration while no aggression is associated with larger decreases in mean HR and systolic blood pressure than physical aggression. Averill (4) recorded autonomic responses from three groups of subjects as they viewed a sadness-inducing film, and a comedy film. Psychological reactions indicated that the stimulus films were effective in eliciting sadness and mirth. Physiologically, sympathetic activation was common to both emotions, with cardiovascular changes more prominent during sadness and respiratory changes more characteristic of mirth. Similar results are reported by Malmstrom *et al*. (62). Their subjects viewed the movie "Subincision" which previous research had shown to be stressful and to stimulate autonomic arousal responses. The heart rate curves derived from the method of mean cyclic maxima showed a close correspondence to the peaks of psycholgical stress produced by the film content. Wenger *et al*. (86) found increases in systolic and diastolic blood pressures, palmar conductance, and number of galvanic skin responses as male subjects read sexually-stimulating material. The heart and respiration rates remained relatively constant.

Dykeman *et al*. (26) presents data showing that subjective and objective measures of personality and emotionality appear to be less important determiners of physiological levels than the intensity of stress. This view is supported by the work of Lazarus *et al.* (51) and Mefford *et al.* (63). In all three studies the HR was used as one of the indices of physiological stress.

Studies dealing with heart rate conditioning in humans have been undertaken by Bersh *et al.* (8), Notterman *et al.* (66, 67), Obrist *et al.* (70), Zeaman and Smith (89), Riege and Peacock (73), and Hnatiow and Lang (35). In the latter study, human subjects learned to reduce cardiac variability when a visual display provided synchronous feedback of their own heart rate. The increased stability was unaccompanied by significant changes in average heart rate and was relatively unrelated to respiration changes.

Autonomic variability is distinguished clearly from activity level. The latter phenomena is measured by average heart rate, and in the resting organism it is relatively uncorrelated with rate stability (48, 1). Shearn (79) attempted to control average heart rate by operant conditioning methods. He demonstrated that cardiac accelerations increase when they provide the contingency for shock avoidance.

The mechanism of learned control of heart rate is not all clear. There is some evidence that respiration plays some role in learned control of heart rate (73), while Wenger, Bagchi and Anand (87) proposed that Indian yogis slow their heart rate via a striated muscular mechanism.

Sex differences in autonomic responses during instrumental conditioning have been studied by Graham _et al_. (33). Women were found to have lower levels of galvanic skin response activity and higher heart rates. GSR discrimination during avoidance learning was less pronounced for women than for men. Both groups had a tendency for heart rate to slow when behavior was inhibited by instruction.

In studying psychological factors related to cardiovascular responses, Reisner _et al_. (72) and Weiner (85) found significant changes in the cardiac rate of subjects during response to T. A. T. cards, laboratory procedures and interpersonal relations with the experimenter. Ho (36) studied the effects of frustration on intellectual performance and concluded that frustration and its associated physiological concomitants does not appreciably affect complex, intellectual functions. The cardiac rate did increase significantly in his frustrated (goal-blocked) group, but there is evidence that the arousal did not exceed the optimal level. Andreassi (2) presents good evidence that cardiac activity decreased with overlearning and accelerates with original learning.

In comparing physiological activity and performance (repeated blocks of trials of simple auditory reaction time) in children and adults, Elliott (29) showed that children differed from adults in that they manifested (a) no covariation between quality of performance and level of physiological activity, (b) far lower intra-individual correlations between one physiological response and another, (c) no adaptation over the experimental session, (d) far weaker relations between interstimulus intervals and reaction time, and (e) increases, rather than decreases in the amplitudes of the various EEG frequencies with increasing motivation and physiological activity. Papers dealing with changes in electroencephalograms and other physiological measures during behavioral performance generally show that EEG amplitude usually covary with HR and other physiological functions in a manner expected from activation theory (57, 58).

Although the research cited involves arousal theory and emotional phenomena, pedagogical conditions are not included. Such studies have not been found. Classroom events appear unique and, therefore, should evoke unique arousal patterns. Telemetric data of the heart rate have been collected from students doing motor skills (45, 71). The present research involves telemetric determinations of cardiac arousal during behavioral performance of students in actual classroom situations.

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CHAPTER III

METHODS AND PROCEDURES

Subjects

Thirty-two male undergraduate students, ranging in age from eighteen to twenty-one years, participated in the study. Their weight ranged from 120 to 200 pounds with only two subjects over 190 pounds. The subjects were recruited from the introductory psychology course taught at North Texas State University. Undergraduates in the introductory psychology course were chosen because many of the classes were scheduled to meet in an experimental classroom provided with microphones and observational one-way windows. Females were excluded because facilities were not available for the manipulation of chest electrodes.

The Taylor (3) manifest anxiety scale was administered to each of six classes meeting in the experimental classroom on Monday, Wednesday and Friday at the following hours: eight, ten, eleven, one, two and three o'clock. Brief biographical data from each student were obtained at this time. From the biographical data, seven to twelve non-smoking freshmen and sophomore males not over twenty-one years of age from each class were chosen as potential participants. The first six males volunteering and available from each of the six groups were arbitrarily selected as subjects. Students with a history of "heart trouble," as indicated in the biographical information, and those receiving medical treatment or taking drugs were not considered in the selection because such factors might have influenced cardiac activity to limits far beyond that of the majority of subjects (Appendix A).

The above days and classes were chosen in order to provide some time (Tuesdays and Thursdays) between recording sessions for equipment adjustments, note taking, and for making contact with subjects and cooperating teachers.

The biographical data and the anxiety scores were obtained in order to have a possible reference guide in the interpretation and discussion of results. The Taylor MAS was selected because it is a brief, objective and quantitatively scorable research instrument, and because it is designed for group administration. The scale purports to be very useful as an overall measure of anxiety. The MAS required from five to ten minutes for administration. A copy is included in Appendix D.

Nineteen of the subjects had not taken internally food or drink during the hour prior to the recording session. The others had taken in food, coffee or coke. Twenty-two of the subjects had walked three to four blocks to the classroom; the others had walked less. Four of the subjects were engaged in physical education activity during the hour prior to the class period.

Design of the Study

The four teaching fellows in charge of the introductory psychology classes scheduled in the experimental classroom on Mondays, Wednesdays, and Fridays were asked to cooperate in recruiting subjects for participation in the study. The first teacher was in charge of the eight o'clock class; the second teacher had the ten and eleven o'clock classes; the one and two o'clock classes were taught by the third teacher; and the fourth teacher was in charge of the sixth class taught at three o'clock.

While the subject's heart rate was being monitored, the teacher was requested to ask the subject a general question, give verbal compliments and assurance to the subject following recitation, and then to direct a general threat or ridicule toward the entire class. The teacher was then required to ask the subject a second general question. During the same class period when questioning and recitation took place and complimentary and derogatory remarks were made, the co-operating teacher gave an unannounced short test (Appendix B). This sequence of classroom events prevailed throughout the observation period. However, in some instances, the threatening remarks were articulated with less vigor and sincerity than other comments or directions made by the teachers.

The threatening remarks, the second question, and test varied in time following the teacher's compliments. As much as thirty-five minutes elapsed between the occasion of compliments and test taking.

The general question asked the subjects as well as the test were based upon the general subject matter which the class was currently studying. All subjects were given the same speech messages, the same verbal compliments, and each class received the same type of verbal threat and ridicule, although not verbatim by each instructor (Appendix B). Each test was approximately five minutes in duration and consisted of six multiple-choice questions. All subjects monitored for cardiac activity on each class day took the same test. A different test was given on each of six class days. Items for the first-day test was taken from Musgrave (2), <u>Library of Test Items</u>, Chapter One; the others were taken from

Chapter Four (Appendix C). A total of thirty-two tests were given by the four teaching fellows in a six-class-day period.

On the Friday, Monday, and Wednesday, following six days of questioning, extemporaneous recitation, and test taking, the four cooperating teachers were requested to require fifteen of the subjects to present prepared oral reports while standing before the class. The reports averaged about six minutes in duration and covered the general area of Ego Defensive Mechanisms.

Approximately one-half (fifteen) of the subjects were told by the experimenter at the time the electrodes were attached that they would not be given a test nor asked to recite impromptu during the class period when, in fact, they were given these tasks. This first group was labeled non-anticipatory. The other subjects (seventeen) were told the opposite and were indeed expecting some speech message from the teacher to which they must respond verbally or by writing. These subjects are referred to as the anticipatory group. The heart rate recording of the former group was repeated during their presentation of prepared oral reports to the class. From fifty-four attempts, forty-seven successful recording sessions were held requiring nine-class-day periods between March 31 and April 23, 1969. Heart rate recordings were taken from one subject per class, six classes per day. This design was altered when subjects were not available (three periods) and when equipment failed (four periods). On the final day, two subjects in two different classes were monitored during the same class period.

Procedure for Collecting the Data

Each subject was instructed to report to the recording room adjoining the experimental classroom just prior to the beginning of the class. He was immediately told to sit and was given (orally) a preliminary explanation of the procedures and reassurance concerning physiological recording. Following this brief interpersonal contact, the subject was asked to unbutton or raise his shirt, and undershirt where applicable, exposing the entire chest. The episternal region and the area just below the left nipple was cleaned with a gauze pad and alcohol. An area approximately three inches in diameter was shaved from the episternal region of those individuals with hairy chests. The cleaned regions were rubbed several times with a rough plastic sponge in order to remove any necrosed epithelial cells. Two surface electrodes previously prepared with electrode paste and adhesive washers were attached, one on the subject's sternum at the manubrosternal junction (red lead cable) and one two inches below the left nipple (black lead cable). The electrode connector (lead cables) was routed through the middle of the shirt or through the neck region in those cases where subjects wore undershirts. A biotelemetry transmitter (Biolink model 334A) housed in a leather case and attached to a belt was then fastened around the subject's waist. The transmitter was 10.2 cm long, 6.4 cm wide, and 2.3 cm thick. The electrode connector was inserted and the transmitter tuned to the "on" position. The subject's heart rate was monitored briefly at this point. When good cardiac rate readings were obtained from the biotachometer dial, the subject was instructed to enter the classroom and to carry on his classroom activities as usual. No specific seating arrangements were required since all seats were visible from the observation windows. The distance between the subjects and biotachometer ranged from approximately four to twelve meters.

Cardiac activity was monitored by employing a Sansui FM Tuner-Receiver amplifier (model 250) coupled to a biotachometer (model 4410C). A half wave folded dipole for the receiver was made from standard 300 ohm twin leads and mounted over one of the observation windows. Audio monitoring of the heart rate was accomplished by an AM/FM, 13 transistor receiver (RE1915N, JT6C2) dialed to Channel 88. This technique permitted monitoring the operable efficiency of the transmitter and facilitated adjustments of the receiver amplifier controls. In the latter case, for example, the volume and balance had to be adjusted appropriately to the threshold level of the biotachometer.

The cardiac rates of the first fifteen subjects (non-anticipatory) were recorded on data sheets (Appendix A) at least five times at six- to twelve-second intervals during each of nine specific classroom events or dispositions of the subjects: (1) initial rest, (2) receiving first speech message, (3) reciting extemporaneously, (4) receiving compliments and assurance, (5) receiving threat or ridicule, (6) receiving second speech message, (7) reciting extemporaneously a second time, (8) taking a test, and (9) resting. During the time the next seventeen subjects were being monitored (non-anticipatory subjects), the heart rate was recorded each fifteen seconds the subject was in the classroom. This time interval also covered the above nine specific dispositions of the subject. As one assistant recorded heart rate, another recorded classroom events or activities each fifteen seconds, and the experimenter recorded the subject's movements or activities each fifteen seconds. The assistant recording classroom events also called time from a Bradley day-and-date mechanical clock with a large black second hand. As a double check, a third assistant recorded the heart rate at least five times within shorter intervals during the nine specific classroom occasions. Except for the fourth recorder (third assistant) this same procedure was followed when the first fifteen subjects (the non-anticipatory group) were monitored again for cardiac activity during the periods in which they presented oral reports to the class. (Forty-seven monitoring sessions were held.)

When two subjects were monitored during the same class periods (two occasions), electrodes were attached to both at the beginning of the class. Following the first oral report, the active subject passed the transmitter to the other subject who had been instructed to make the proper electrode-transmitter connection. Ten minutes or more time elapsed before and after these subjects presented their oral report. At no time did the experimenter or assistants enter the classroom. With four exceptions, at least ten minutes of class time elapsed before each subject became actively involved in the class by the teacher. The fifteen-seconds recording sessions lasted from sixteen to forty-eight minutes with an average of thirty-six minutes. At the end of each session, the subject returned to the recording room where the electrodes were removed, cleaned, and prepared for use on the next subject.

Audio from the classroom was obtained by the use of five electro-voice microphones (model 664) suspended from the ceiling in the classroom and coupled to a microphone mixer panel and an amplifier monitor. This arrangement permitted proper balance of audio from classroom and listening volume.

The recording room was darkened during the monitoring sessions in order to facilitate observation through the one-way windows. A small light was mounted on the biotachometer. A light switch was also available to signal the teacher (by a small light in the classroom) when to involve the subject in classroom activity. The signal light was seldom used, however, since the time lapse between classroom occasions appeared to be sufficient for the subject's heart rate to return to or approach the base level. A flashlight was used several times as a signal (through the window) when it appeared that the teacher was not cognizant of the amount of time left in the class period.

For each monitoring session the subject's number, the date and time, and the number of males and females in the classroom were recorded on the data sheet.

Procedure for Treating the Data

The tenability of the hypotheses of this study were determined by standard statistical analysis of the collected data. The .05 level of confidence was used to reject the null hypotheses.

The mean and the standard deviation of cardiac rate for each of the nine classroom occasions were obtained from the six- to twelve-second measures of cardiac rate of the non-anticipatory group and from the fifteen-second measures of the anticipatory group. The same statistics were obtained from fifteen-second measures of cardiac rate of the non-anticipatory group while doing oral reporting. The heart rate during the time of extreme bodily movement such as a shift in sitting position was omitted.

To test the difference in level of cardiac rate between anticipatory and non-anticipatory subjects during the nine classroom occasions (Hypotheses 1-5), Fisher's (2) _t_ test for significant difference between means of unrelated groups was used.

For testing the difference in level of cardiac rate within each group between the different classroom occasions (Hypothesis 6), a Lindquist (1) two factor analysis of variance with repeated measures was used. The Newman-Keuls procedure (5) was used to determine the classroom occasions where the mean cardiac rate was significantly different from the base level of initial rest.

To test the difference in level of cardiac rate for students reciting impromptu and when presenting prepared oral reports (Hypothesis 7), Fisher's (2) t test for significant difference between means of related groups was used.

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CHAPTER IV

PRESENTATION AND DISCUSSION OF RESULTS

The problem of this investigation was patterns of cardiac arousal during response to speech messages in the classroom. The purposes of this study were (1) to determine the relationship between recitation in the classroom and changes in the cardiac rate, (2) to determine the effect on cardiac rate of anticipation with respect to recitation and tests, (3) to determine the effect on cardiac rate of compliments and assurance directed toward students by the teacher, and (4) to determine the effect on cardiac arousal of verbal threat and ridicule.

The subjects used in this study were divided into two groups on the basis of whether they did or did not anticipate specific classroom events. Therefore, the study was concerned with differences in cardiac arousal between the two groups as well as changes in the cardiac rate of the subjects from the base level during the specific classroom occasion. As can be seen in Figure 1, there was heart rate acceleration during each student-teacher interaction or classroom event compared to the base level of initial rest. The mean cardiac

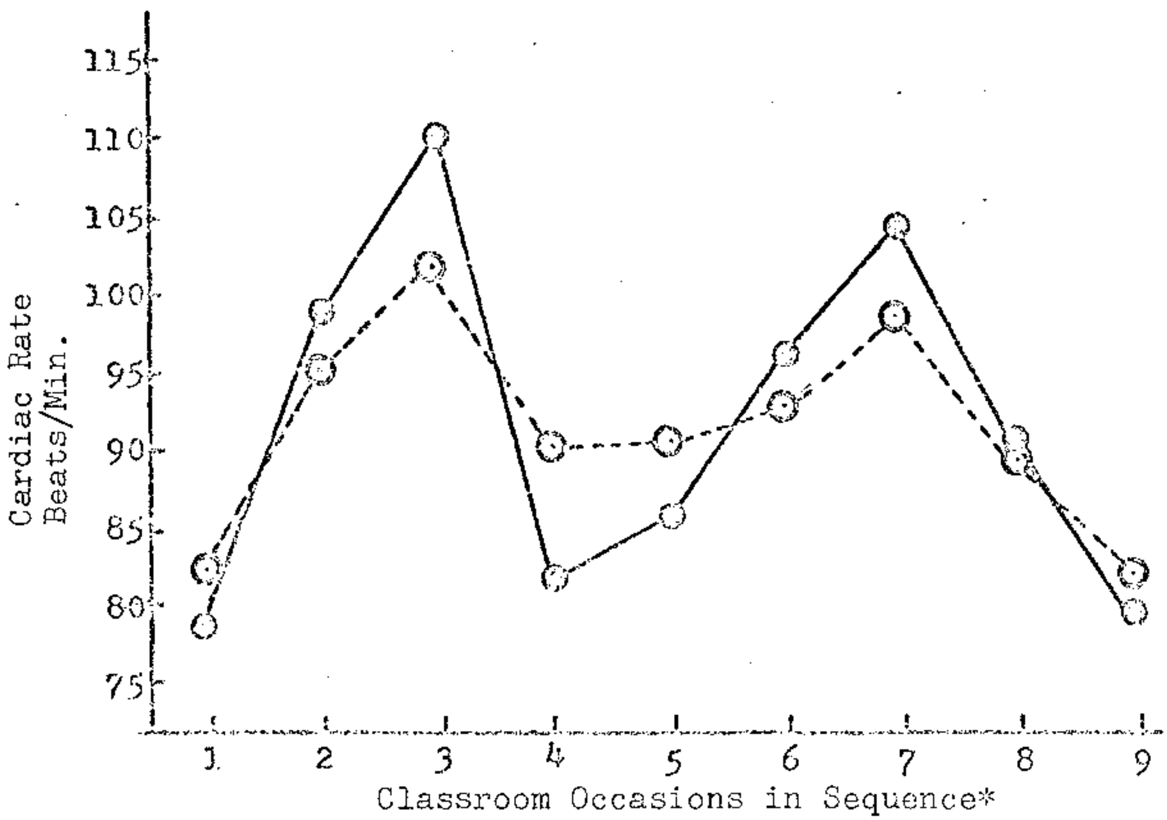

Fig. 1--Mean cardiac rate of non-anticipatory subjects (——●) and anticipatory subjects (----⊙) during nine classroom occasions.

*1--Initial rest, 2--Receiving first speech message, 3--First recitation, 4--Receiving compliments, 5--Receiving threat, 6--Receiving second speech message, 7--Second recitation, 8--Taking test, 9--Rest.

rate for the anticipatory subjects during the occasions of initial rest, compliments, and threat was generally higher than the mean cardiac rate of the non-anticipatory subjects. The anticipatory subjects responded about equal to the compliments and threatening remarks of the teacher. The mean heart rate of the non-anticipatory group was somewhat higher during the occasions of threat than that shown during compliments and assurance. The mean heart rate of the latter group was also shown to be somewhat lower than the anticipatory subjects during the classroom occasion of rest. The first recitation evoked significantly higher cardiac responses in both groups than did the second recitation.

The pattern of cardiac arousal as depicted in Figure 1, indicate that the classroom or teaching session provides variable stimuli which evoke correspondingly different degrees of arousal.

Hypothesis number one predicted that a significant difference would be found in the mean cardiac rates of students receiving unanticipated speech messages from the teacher when compared to those receiving anticipated messages. As can be seen in Table I (first message) students expecting to be called upon to recite in class had a lower mean cardiac rate than non-anticipatory students, but not significantly different by statistical test. In this case, the null hypothesis that no significant difference will be found could not be rejected, and the research hypothesis was not accepted. Also in Table I will be found the mean cardiac rate of the two groups while receiving the second speech message from the teacher. Although there was considerable increase in cardiac activity from the base level (initial rest) in both groups, there was no significant difference found in the mean cardiac rate during message reception. The cardiac rate of the anticipatory group during these two occasions was generally lower.

TABLE I

MEAN CARDIAC RATE OF ANTICIPATORY AND NON-ANTICIPATORY SUBJECTS DURING NINE CLASSROOM OCCASIONS AND COMPARISON BY *t* TEST OF THE GROUPS DURING EACH OF THE OCCASIONS

Classroom Occasion	Non-Anticipatory Subjects (N = 15)		Anticipatory Subjects (N = 17)		*t*	P
	Mean	S.D.	Mean	S.D.		
Initial Rest	78.47	10.28	83.06	12.95	1.06	N.S.
Receiving First Message	98.53	11.17	95.02	15.85	.69	N.S.
Reciting	110.16	10.36	102.20	17.80	1.47	N.S.
Receiving Compliments	82.69	12.35	90.23	14.14	1.55	N.S.
Receiving Threat	86.52	11.35	90.33	14.64	.79	N.S.
Receiving Second Message	96.81	10.91	93.76	16.60	.58	N.S.
Reciting	104.90	12.29	97.39	16.18	1.42	N.S.
Taking Test	90.50	10.42	90.36	14.48	.03	N.S.
Rest	79.22	9.68	82.53	12.95	.78	N.S.

The second hypothesis of this study predicted that students reciting impromptu would show a significant difference in mean cardiac rate compared to those reciting extemporaneously with expectation. The *t* technique revealed no significant difference between the two groups during the classroom occasion of recitation (Table I), therefore, the research hypothesis could not be accepted. Whereas cardiac activity was much higher during the recitation occasion in both groups than their base level, the non-anticipatory subjects showed a generally higher mean cardiac rate while reciting than did the anticipatory group. This higher mean cardiac rate for the non-anticipatory group was also found during the response to the second speech message from the teacher (Table I). In both instances, however, the two groups did not differ significantly by statistical test.

The increased cardiac activity during recitation may be taken as evidence that actual participation in classroom events is far more arousing or activating than merely sitting in the classroom passively involved. While increased activation might be expected when students are actively involved in classroom events, quantitative measures of the degree of arousal in the classroom have not been made before. Data such as these should assist in determining various levels of arousal evoked by specific classroom events.

The third hypothesis was predicated upon the assumption that compliments and assurance from the teacher would have the conciliatory effect of reducing stress and anxiety evoked by recitation in the classroom. As shown by the t technique (Table I), the two groups did not differ significantly in mean cardiac rate during the classroom occasion of compliments and assurance. Therefore, the research hypothesis was not accepted. There was considerable decline in cardiac activity in both groups following recitation, with the non-anticipatory students showing the highest level in cardiac activity during the occasion of compliments and assurance. Deceleration was slower in those cases where the compliments following recitation was delayed.

Hypothesis number four predicted that a significant difference would be found in the mean cardiac rate of anticipatory and non-anticipatory students during the classroom occasion of threat or ridicule directed toward students by the teacher. The mean cardiac rate for the anticipatory group during this occasion was 90.33 ± 3.55 compared to 86.52 ± 2.93 for the non-anticipatory subjects. Although the difference was non-significant by the t test, it should be noted that the mean cardiac rate during this occasion was considerably higher for both groups than during their disposition of rest and initial rest (Figure 1, Table I). This would indicate that the threatening remarks, although articulated in some instances with less vigor and sincerity than other comments or directions by the teacher, did have some arousal or activating effects. The threat and ridicule did not immediately follow the previous specific classroom event as was the case in most instances of compliments and assurance.

The fifth hypothesis of this study stated that there would be a significant difference found in the mean cardiac rate of students taking an unannounced test without anticipation compared to those anticipating the test. The difference in mean cardiac rate of the two groups during the classroom occasion of test taking was only .14 (Table I). The null hypothesis that no significant difference will be found between the two groups during the test taking could not be rejected. Fluctuations in the cardiac rate of both groups appeared to be greater while taking the tests than during the other classroom occasions.

The fact that no significant difference was found in the mean cardiac rate of anticipatory and non-anticipatory subjects during the specific classroom occasions might be accounted for by several factors. Some subjects suspected that their involvement in the classroom events would not jeopardize or influence their scholastic grade or standing in the course. Therefore, the test taking and recitations were not as threatening as might have been under other circumstances. The above attitude was revealed when subjects were asked at the end of the class period to give a brief retrospective account of their feelings about being monitored for cardiac activity.

Another possible factor may be attributable to the cooperating teachers. Not all were equally demanding of their students. Although this might be expected among teachers, it points up the need for research to determine the effects on arousal of teacher personalities and teaching methodologies.

As indicated earlier, whereas no significant difference in the mean cardiac rate was found between the two groups, Figure 2 clearly illustrates that heart rate acceleration occurred in both groups during each student-teacher interaction. This effect might be found to have some significance for education theory and practice. If stress can best be understood within the framework of group interaction, communication, and influence as Lazarus (8) and Mechanic (11) argue, then the classroom is virgin and stands open for

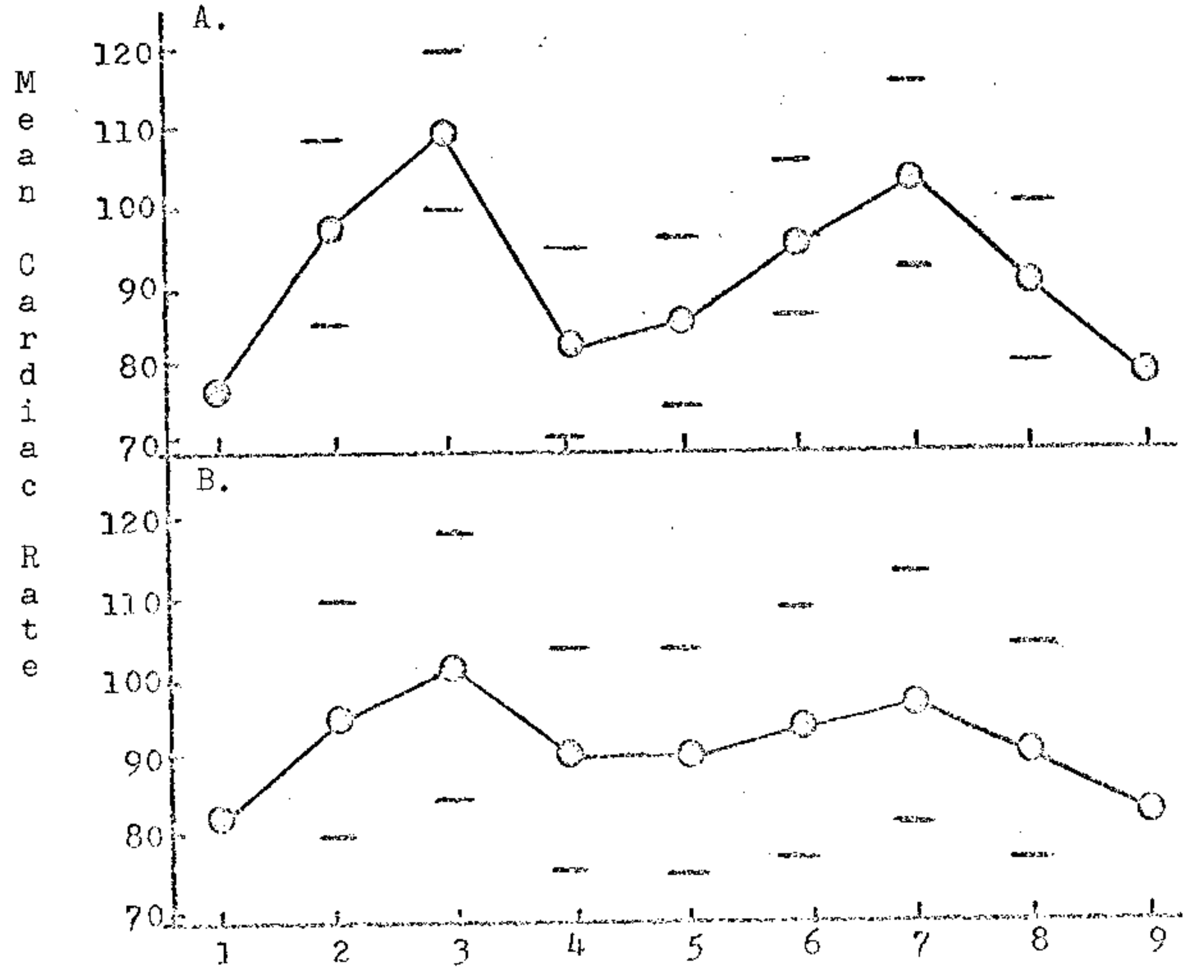

Fig. 2--Effects of classroom events on the mean cardiac rate of non-anticipatory (A.) and anticipatory subjects (B.). 1--Initial rest, 2--First message, 3--First recitation, 4--Compliments, 5--Threat, 6--Second message, 7--Second recitation, 8--Taking test, 9--Rest.

research and exploration of stress phenomena and their relationship to the teaching-learning process. Student-teacher interactions or classroom situations might be found which evoke desired levels of arousal.

As can be seen in Figure 2, the pattern of cardiac arousal of students in the classroom appeared as fluctuations corresponding to specific classroom events. The bars above and below each solid circle in the figure indicate the standard deviation of the cardiac rate. Heart rate variability of the non-anticipatory group (Figure 2-A) was about equal to that of the anticipatory subjects (Figure 2-B). Excluding rest and initial rest, there was less cardiac rate variability during the classroom occasions of compliments and threat when compared with message reception, recitation and taking test.

Heart rate acceleration of students in the classroom might indicate occult emotional reaction which might be present and prevailing in students which in turn may effect their cognition, perception and responses.

The sixth hypothesis of this study predicted that the different classroom events would evoke significantly different levels of cardiac arousal. Table II presents a comparison of the mean cardiac rates using a Lindquist (10) two-factor analysis of variance with repeated measures. The total between group difference in cardiac rate for the entire experimental procedure did not approach significant level, suggesting that neither group had a higher overall cardiac rate. There was a significant total between occasion difference ($<.01$), indicating that the various classroom events evoked different levels of cardiac rate. The interaction of the groups was also significant ($< .01$), indicating that the different classroom occasions evoked changes in cardiac rate differently for the anticipatory and non-anticipatory subjects (see Figure 1). The null hypothesis that no significant difference would be found in level of cardiac rate in the groups between the different classroom events was rejected.

TABLE II

ANALYSIS OF VARIANCE OF MEAN CARDIAC RATE FOR ANTICIPATORY AND NON-ANTICIPATORY SUBJECTS

Subjects	Source of Variation	DF	SS	MS	F	P
Total (N=32)	Between Subjects	31	38,438.90			
	Between Group	1	7.40	7.40	.006	N.S.
	Error B	30	38,431.50	1281.05		
Anticipatory (N=17)	Within Subjects	256	33,929.50			
Non-Anticipatory	A	8	18,945.50	2368.19	43.59	$< .01$
(N=15)	AB	8	1,943.80	242.98	4.47	$< .01$
	Error W	240	13,040.20	54.33		
	Total	287	72,368.40			

The Newman-Keuls procedure (14) was used to determine the classroom occasion where the mean cardiac rate was significantly different from the base level of initial rest. The results will be found in Table III. The means for both groups were pooled (total scores). The classroom occasions in rank order from low to high were rest, initial rest, receiving compliments, receiving threat, taking test, receiving second speech message, receiving first speech message, second recitation, and first recitation.

The numbers in the top of Table III and in the left margin are the total scores of the pooled mean cardiac rates. The total scores during the different classroom occasions in rank order from low to high were derived by: $\frac{\overline{X}_1(N_1) + \overline{X}_2(N_2)}{2}$. The numbers in the body of the table give the difference in the pooled mean cardiac rate between the lowest value and the next highest pooled mean cardiac rate (total score) in increasing order. The differences are compared with q.95 $(r,240)\sqrt{\text{NMS error}}$ given at the bottom of the table. The differences are significant when greater than the corresponding value in the lower table.

The mean heart rate during the first four occasions above (a, b, c, and d of Table III) were not significantly different from one another. Beginning with test taking (e)

TABLE III

TEST ON CARDIAC RATE MEANS USING NEWMAN-KEULS PROCEDURE SHOWING THE CLASSROOM EVENT WHICH EVOKED A MEAN CARDIAC RATE SIGNIFICANTLY DIFFERENT FROM OTHER MEANS

Classroom Occasions & Rank Order Scores from Low to High	a Rest	b Initial Rest	c Receiving Compli-ments	d Receiving Threats	e Taking Test	f Receiving Second Message	g Receiving First Message	h Second Recita-tion	i First Recita-tion
	1264.65	1294.53	1387.13	1416.70	1446.81	1523.03	1546.64	1614.56	1693.40
1264.65	——	29.88	122.48	152.05	182.16*	258.38*	281.99*	349.91*	428.75*
1294.53		——	92.60	122.17	152.28	228.48*	252.11*	230.03*	398.87*
1387.13			——	29.57	59.68	135.90	159.51	227.43*	306.27*
1416.70				——	30.11	106.33	129.94	197.86*	276.70*
1446.81					——	76.22	99.83	167.75	246.59*
1523.03						——	23.61	91.53	170.37
1546.64							——	67.92	146.76
1614.56								——	78.84
1693.40									——
r steps (in letters)		b	c	d	e	f	g	h	i
q.95 (r,240)		2.77	3.31	3.63	3.86	4.03	4.17	4.29	4.39
q.95 (r,240)$\sqrt{\text{MS error}}$		115.50	138.01	151.35	160.95	168.03	173.87	178.87	183.04

*Significant.

the other classroom events (f, g, h, and i) evoked significant higher mean cardiac rates than did the former four.

The mean heart rate during message reception (f, g) and reciting (h, i) was significantly higher than that found at test taking. Reciting (h, i) evoked a significantly higher mean cardiac rate than message reception. Although not significantly different, the first speech message (g) was more arousal-provoking than the second speech message (f). The mean heart rate during the first recitation (i) was found to be significantly higher than that found during the second speech message (h).

The mean cardiac rate in increasing order as given above and the fluctuating mean heart rate of subjects during the entire class period as shown in Figure 1 suggest that specific classroom events might evoke specific levels of degrees of arousal. Many further explorations of autonomic responses of students in actual classroom situations are needed to determine possible relationships between classroom events, autonomic responses and mental performance. As Mordkoff (12) points out, while some relationships between psychological and physiological responses to stress have been shown, our knowledge of emotion and psychological stress is still incomplete.

Again it should be pointed out that while some classroom events might be expected to evoke higher levels of activation than others (based upon stimulus-response theory), the quantitative measures of the arousal level of students may also serve to evaluate stimulus sources in the classroom.

Following the observations on the cardiac rate of the non-anticipatory group, the design of the study called for heart rate monitoring of these subjects during the class period when they were presenting prepared oral reports while standing before the class. The seventh hypothesis predicted that the non-anticipatory group would exhibit a significantly higher level of cardiac activity during the class period in which they presented oral reports compared to the class period in which they recited impromptu or extemporaneously. As determined by the _t_ test, the mean cardiac rate for the group during the class period of oral reporting was significantly higher when at initial rest than during the class period of impromptu recitation (Table IV). The null hypothesis was rejected and the research hypothesis accepted. Although no significant difference in cardiac activity of the oral reporting group was observed during other classroom occasions (message reception, recitation and rest), there was an increase in the mean cardiac rate during these occasions compared to the previous class periods. When the group was reciting extemporaneously, the cardiac rate accelerated from a mean base level of 78.47 ± 2.65, to a mean of 110.16 ± 2.67, a gain of 31.69 beats per minute. When the same group was presenting oral reports, the heart rate accelerated from a mean base level of 90.56 ± 4.96 to a mean of 115.88 ± 7.12, a gain of 25.32 beats per minute.

TABLE IV

MEAN CARDIAC RATE OF NON-ANTICIPATORY SUBJECTS DURING EXTEMPORANEOUS RECITATION AND PRESENTATION OF ORAL REPORTS AND COMPARISON BY *t* TEST

Classroom Occasion	Extemporaneous Recitation N=15		Presentation of Prepared Oral Reports N=15		*t*	P
	Mean	S.D.	Mean	S.D.		
Initial Rest	78.47	10.28	90.56	19.23	2.35	< .05
Receiving Message	98.54	11.17	99.36	19.00	.16	N.S.
Reciting in Class	110.16	10.36	115.88	27.59	.78	N.S.
Rest	79.22	9.68	84.52	17.63	1.12	N.S.

This evidence indicates that anticipation of rising and walking before the class to recite was far more arousing or stressful than non-anticipation of this classroom task.

Furthermore, the evidence suggest that anticipation of standing before the class reciting evokes much higher levels of arousal than contemplation of reciting while sitting among fellow students. It should be recalled that the anticipatory subjects did not differ significantly in mean cardiac rate from the non-anticipatory group during the classroom occasion of initial rest.

The mean cardiac rate of the group during oral reporting and impromptu recitation are graphically represented in Figure 3. As indicated in the figure, the mean cardiac rate of the group was considerably higher during the class period in which they presented prepared oral reports compared to the class period in which the same non-anticipatory group recited impromptu. As also shown in Table IV and discussed elsewhere, the mean cardiac rate during extemporaneous recitation was 110.16 $\pm$ 2.67 compared to 115.88 $\pm$ 7.12 during oral reporting. The former includes the first recitation only.

It was noted (Table I) that the anticipatory subjects had a slightly higher mean cardiac rate during the classroom occasion of rest and initial rest than the non-anticipatory group. The anxiety scores as determined by the Taylor (13) Manifest Anxiety Scale, ranged from five to thirty-six for

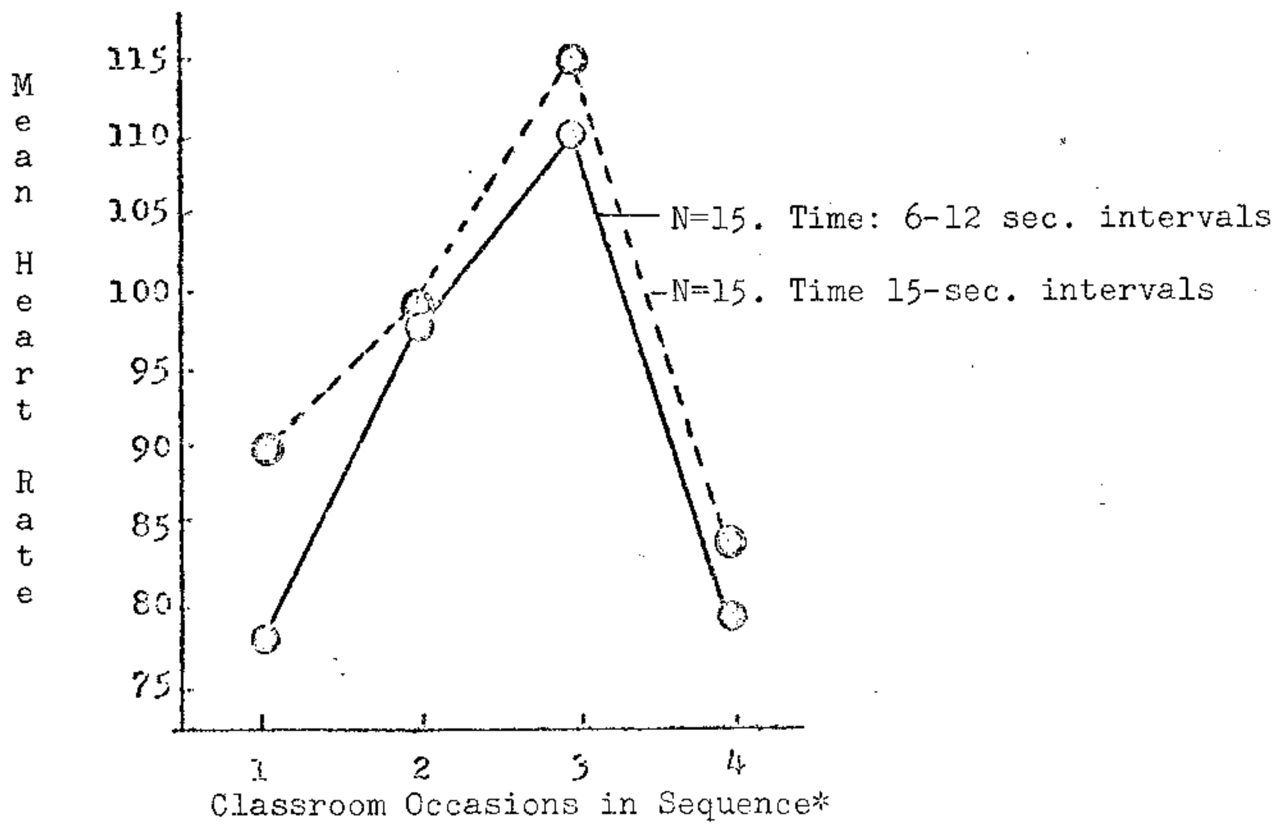

Fig. 3--Mean cardiac rate of non-anticipatory subjects during extemporaneous recitation (——●) and presentation of prepared oral reports (----○).

*1--Initial rest, 2--Receiving message, 3--Reciting in class, 4--Rest

the anticipatory group with a mean score of 17.32. The anxiety scores for the non-anticipatory subjects ranged from zero to thirty-four with a mean score of 14.13. The conflicting results of research on anxiety and physiological activity (5, 7, 9), and the paucity of literature dealing autonomic responses of students while in the classroom, testify to the need for research in this area.

The arousal theory holds that situations having a high degree of significance for the individual, will, if other factors are constant, produce a high level of arousal while the converse is true for those situations having a low degree of significance (4). When the heart rate is taken as the indicant of arousal, recitation in the classroom is highly significant to the student. A marked increase in cardiac activity was observed whenever the subject wished to recite as indicated by a raised hand. Reciting while sitting was about equally arousing or stressful as standing before the class (Table IV). The slightly higher cardiac rate of students in the latter case might be attributable to greater physical activity during this classroom task.

The fact that students anticipating the oral reports had a significantly greater mean cardiac rate during the period of initial rest than when they were not anticipating recitation strongly support the thesis discussed by Lazarus (8) that threat is subjectively worse than the actual confrontation with a situation. This view is further supported by the research findings of Mechanic (11). In studying the stress of students produced by preliminary examinations for the doctorate degree, Mechanic (11) showed that anticipation of the examination and waiting for the results produced far more psychosomatic symptoms than when actually taking the examination.

When a student anticipates recitation along with others, there was increasing heart rate acceleration as his time to speak approached. A similar pattern of increasing anxiety has been observed in doctoral students as the preliminary examinations approached (11).

In group discussion it was observed that the heart rate of the subjects exhibited greater acceleration when another student recited than when the teacher was talking. Acceleration was higher when a female student recited than when another male recited.

When the teacher called upon the subject to recite or asked him a question, there was increased cardiac activity. Whenever the teacher rephrased the question, there was momentarily deceleration of the heart rate. Noticeable accelerative changes in the cardiac rate of the subjects were observed when the teacher called the class to attention, when there was general laughter in the class, and when the teacher made physical approaches toward the subjects.

The slightly lower mean cardiac rate of the anticipatory subjects during recitation may represent a reflection of psychological stress and the coping process described by Lazarus (8). Research on a large number of students is needed to elucidate psychological stress in the classroom and the coping process.

The design of this study was predicated upon the assumption that autonomic variability may have facilitory effects on receptor-cortical functions. In a variable arousal pattern, such as might be found in a classroom, subjects can respond differentially to various aspects and elements within a situation, and these differential reactions may serve to facilitate functioning. If the facilitating effect of arousal is to "tone up the cortex" as Hebb (6) suggests, a constant state of arousal, regardless of level, may reach habituation. Changes and variations in arousal level may be more effective in maintaining a general level of cortical excitation. At the extreme ends of the arousal continua where arousal is exceedingly low or exceedingly high, there is relatively little variability of response. It is only in the middle ranges of the arousal continua where reactions can vary and fluctuate. As Blatt (1) points out, the capacity for differential reaction and response may be the important facilitating effect rather than the absolute level of the arousal.

The research data presented here indicate that classroom activities and events evoke changes and variations in cardiac arousal which reflect variability in the general arousal level. Cardiac arousal appeared as fluctuations patterned after different classroom events.

Granted that the climate for learning is the product of the kinds of interactions students have with the teacher (3), and that emotional factors play an important role in all learning processes (2), any attempt to speculate on the role teaching plays or should play in arousal would be premature at this time. The teaching-learning process and situations with respect to arousal must be explored much further before definitive conclusions can be drawn on teaching and arousal phenomena. No attempt was made in this investigation to relate learning with arousal.

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CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Summary

The present investigation was an attempt to explore the relationship between selected classroom events and cardiac arousal. The problem was the effects of speech messages on the cardiac rate of students in the classroom.

The purposes of this study were (1) to determine the relationship between recitation in the classroom and changes in the cardiac rate, (2) to determine the effect on cardiac rate of anticipation with respect to recitation and tests, (3) to determine the effect on cardiac rate of compliments and assurance given to students by the teacher, and (4) to determine the effect on cardiac rate of verbal threat and ridicule directed toward students by the teacher.

By employing electrocardiotachometry and biotelemetry techniques, thirty-two male students were monitored for cardiac activity during nine classroom occasions or dispositions of the students. The occasions were (1) initial rest, (2) receiving first speech message from the teacher, (3) first recitation, (4) receiving compliments, (5) receiving threat or ridicule, (6) receiving second speech message, (7) second recitation, (8) taking test, and (9) rest.

The students, recruited from the introductory psychology course taught in an experimental classroom at North Texas State University, were divided into two groups. One group (the first fifteen subjects to be monitored) did not anticipate the classroom events and were referred to as non-anticipatory subjects. The other group was told to expect the events and was referred to as the anticipatory subjects. Repeated heart rate recordings were taken from the non-anticipatory group during the class period in which they presented prepared oral reports to the class.

A total of forty-seven heart rate monitoring sessions were held, requiring nine class-day periods. One subject per class was monitored in a maximum of six classes per day. During the first fifteen monitoring sessions the heart rate was recorded at six- to twelve-second intervals during the nine dispositions of the subjects or classroom events. For the following thirty-two monitoring sessions, heart rate recordings were taken each fifteen seconds the subject was in the classroom. The mean and standard deviation of the cardiac rate for each of the nine classroom occasions were obtained from the six- to twelve- and fifteen-second measures of cardiac rate. These same statistics were obtained from measures on the non-anticipatory group while presenting oral reports. A two-factor analysis of variance and Fisher's t test were used in analyzing the data. The .05 level of confidence was used to reject the null hypotheses.

Hypotheses one through five predicted that the non-anticipatory subjects would exhibit a significant difference in mean cardiac rate during the specific classroom events given above when compared with the anticipatory group. Of the nine classroom occasions, none were found with a t ratio which was significant at greater than the .05 level. The null hypotheses could not be rejected. Two possible explanations were suggested as to why the two groups did not differ significantly in mean cardiac rate during the nine classroom occasions. They were the following: (1) some of the subjects from both groups admitted that they suspected that their scholastic standing or grade in the course would not be influenced or jeopardized as a result of reciting and taking tests while being monitored for cardiac activity, and (2) not all the cooperating teachers were equal in vigor and sincerity in articulating the speech messages.

The sixth hypothesis of this study predicted that different classroom events would evoke significantly different levels of cardiac arousal. A two-factor analysis of variance revealed a significant F ratio ($<.01$) between the total and occasion difference, indicating that the various classroom events evoked significantly different levels of cardiac rate. The null hypothesis was rejected. The interaction of the groups was also significant ($<.01$), indicating that the different classroom occasions evoked changes in cardiac rate differently for the anticipatory and non-anticipatory subjects.

Tests were made on the difference between all possible pairs of means. The mean cardiac rates in rank order from low to high for the groups (combined) during the nine classroom occasions were as follows: (1) rest, (2) initial rest, (3) receiving compliments, (4) receiving threat, (5) taking test, (6) receiving second message, (7) receiving first message, (8) second recitation, and (9) first recitation. The mean cardiac rate of the subjects during the first four occasions were not significantly different from one another. Beginning with test taking, the other classroom events evoked significantly higher mean cardiac rates than the former four. The mean heart rate during message reception and reciting were significantly higher than at test taking, and reciting evoked significantly higher mean cardiac rates than did message reception. The mean cardiac rate was significantly higher during the first recitation than that found during the second recitation. These findings were regarded as evidence that some classroom events evoke significantly higher levels of cardiac activity than do others.

The seventh hypothesis of this study predicted that the non-anticipatory group would exhibit a significant difference in mean cardiac rate during the class period in which they presented prepared oral reports compared to the class period in which they recited impromptu or extemporaneously. A comparison of different mean cardiac rates of the groups during four classroom occasions was made, using the *t* technique, to determine if there was a significant difference between them during the two different kinds of classroom situations. The results of these *t* tests were as follows:

1. Comparison of mean cardiac rate during initial rest indicated very high arousal for the group faced with presenting an oral report to the class. This comparison yielded a *t* ratio 2.35 or $P < .05$.

2. Comparison of mean cardiac rate during message reception (when the teacher was calling upon the student to recite) yielded no significant difference ($t = .16$).

3. Comparison of mean cardiac rate of the group during recitation in the classroom (impromptu recitation and

presenting oral reports) was also non-significant by the t test (t = .78).

4. During the classroom occasions of rest, the group which presented prepared oral reports had a mean cardiac rate of 84.52 ± 4.58 compared to a mean rate of 79.22 ± 2.50 during the class period of impromptu recitation. The means were not significantly different (t = 1.12).

In summary, the findings of this research were as follows:

1. During the first thirty-two heart rate monitoring sessions, students anticipating the classroom events did not differ significantly in mean cardiac rate when compared with students contemplating the events.

2. Students anticipating the classroom task of standing before the class presenting prepared oral reports (the latter fifteen monitoring sessions) were found to have a significantly greater mean cardiac rate during the occasion of initial rest when compared with themselves during this occasion in the classroom in which they did not anticipate classroom events. The heart rate was generally higher during the class period of oral reporting.

3. The mean cardiac rate (from low to high) of both anticipatory and non-anticipatory subjects was found to be

significantly higher during the classroom occasion of taking test, second message reception, first message reception, second recitation and first recitation when compared with the mean heart rate shown during rest, initial rest, ridicule or threat and compliments.

4. The mean heart rate during message reception was found to be significantly higher than that found during test taking. Recitation evoked a significantly higher mean cardiac rate than did message reception. The mean heart rate during the first recitation was found to be significantly higher than that found during the second recitation.

5. When compared with the base level of initial rest, increased cardiac activity was observed in both anticipatory and non-anticipatory subjects during each student-teacher interaction.

The research findings in this study were discussed relative to arousal theory, stress, anxiety, the teaching-learning process, and the need for further research in these areas.

Conclusions

The following conclusions were formulated upon the basis of the findings in this study.

1. It was concluded that interactions of student-teacher will evoke increased arousal. The level of arousal would appear to depend upon a number of extrinsic and intrinsic factors.

2. Different classroom tasks and events such as message reception, reciting and taking tests will evoke different levels of arousal in both anticipatory and non-anticipatory students.

3. Anticipation of certain classroom events (such as the presentation of prepared oral reports) is subjectively more arousing or stressful than actual confrontation with the situation.

4. It is concluded that the research findings reported here lend support to arousal theory. Since any increase in arousal accompanies an increase in physiological activity, the accelerated heart rate measurements made here indicated increasing significance or emotional value of the situation to the individual.

Implications

The following implications have evolved from the observations, results, and conclusions of this study.

1. The heart rate of students appears to be a suitable parameter to study in the classroom. As a physiological

indicant of arousal and signifying the significance of a situation to an individual, the heart rate might be used to quantitatively evaluate classroom events in terms of their importance to the student and in terms of their value or significance in the teaching-learning process. Both of these might provide clues to possible guides to particular teaching approaches, techniques, methods, and teacher attitudes.

2. The threatening remarks in the present study as well as the compliments directed toward students by the teacher appeared to have accelerative effects on cardiac arousal. Threat or ridicule in one form or another has long been a common practice among many teachers. The measurement and study of the heart rate of students in actual classroom situations should elucidate the role that threat might play in their attitudes, values, motivation, and general receptivity of teachers, other students, and classroom experiences. For many attitudional and motivational phenomena are reflected through arousal. The same principle would appear to apply to complimentary remarks and assurance directed toward students by the teacher.

3. Each subject in this study was required by the teacher to make two recitations during the class period. The first recitation was found to evoke a significantly higher

mean cardiac rate than the second recitation. At the college level many students are never asked to recite in class during the entire semester. Several weeks or a semester of heart rate monitoring of students might reveal an arousal pattern distinct enough to show and predict adaptation in the classroom. Being knowledgeable of the teacher's questions and the anticipation of them should also exhibit unique arousal patterns. The knowledge obtained in these regards might facilitate teacher planning as well as provide a more rational basis for the modification of teaching practices.

4. The study of educational psychology has shown that some students have a greater need for becoming involved in classroom events than others. The involvements such as recitation, presenting oral reports, group discussions and taking tests which are usually initiated by the teacher may turn out to be of less significance as determined by autonomic responses than that which is presently suspected.

5. Whereas this research was limited to the cardiac rate, other indices of arousal may very well be measured from students in actual classroom situations. It is conceivable that efficient mental performance, desirable attitudes and emotions might be enhanced as a result of carefully manipulating those classroom events which have been shown to evoke

specific degrees or levels of arousal. The exploration of autonomic responses of students while reading different kinds of materials, while writing, taking different kinds of tests, in group discussion, doing laboratory exercises, in argumentation and debate, and solving different kinds of problems should go far in elucidating the above possible relationships and in providing knowledge to support educational theory and teaching practices.

The measurement and study of autonomic responses of teachers during the above classroom events should also provide clues for teaching practices.

Recommendations

Based upon the research findings, the conclusions and the implications of this study, the following recommendations are made. They fall into two categories, those which would be of value in a replication of this study, and those which would be of value in extending this kind of research.

1. The most difficult problem encountered in this study was in maintaining a steady heart rate reading on the biotachometer. In addition to fluctuations of the dial hand due to normal bodily movements of the subjects, there were at times extreme erratic movements of the dial hand presumably resulting from the combined effects of improper

electrode attachment, momentarily failure of transmitter, and inadequate balance and volume of the Sansui FM receiver-amplifier which was used. This observation strongly suggests that this kind of study should employ a standard biotelemetry receiver coupled to the biotachometer. At least two reliable transmitters should be available. The electrodes should be very carefully prepared and precisely placed. Any wrinkles or creases in the electrode washers, or excess paste might enhance the pickup and transmission of muscle and skin potential.

2. When the biotachometer is used to record the heart rate of students at specified intervals, it is recommended that a more precise signal-timing device be used than the mechanical clock and oral call which was used in the present study. A combination sound and light signal for the time interval should facilitate heart rate and other recordings.

3. It is recommended that all subjects participating in a replication of this study should be made to feel that their scholastic grade or standing depended upon their performance on the tests and in recitation.

4. For more precise correlations of physiological responses with classroom events, it is recommended that when students are monitored for autonomic activity the class

should be video-taped with closed circuit television. The classroom events may also be audio-taped. Video taping the recording instrument simultaneously with classroom events should also facilitate this kind of study.

5. It is recommended that further study relative to autonomic responses of students in actual classroom situations be continued. Comparative studies involving male and female students as well as teachers are needed.

6. Since the degree of activation appears to be best indicated by a combination of measures, it is recommended that attempts be made to telemetrically measure, simultaneously with the heart rate of students, other autonomic responses such as brain wave amplitude (EEG), muscle tension (EMG), blood pressure (BP), respiration (RR), and skin resistance (GSR). Research in this area should be facilitated with techniques whereby several students are monitored simultaneously for autonomic activity.

7. The common practices of students reciting in class and doing other classroom activities are in need of research with respect to autonomic arousal and performance efficiency. Different teacher attitudes and personalities, for example, might correspondingly influence the arousal level of students while doing various classroom tasks. The general anxiety

level of students in a classroom situation, their personalities, physical attributes, health habits, as well as the level of classroom task difficulty should have some relationship with physiological measures. The effects of the physical environment of the classroom on autonomic arousal and possible relationship with mental performance are also in need of research.

8. Related to the above problems is the question of emotional and motivational factors in the teaching-learning process. Since the measurements of physiological indicants of arousal affords, when other factors are constant a direct measure of the "motivating" or "emotional" value of the situation to the individual, it is recommended that research be conducted to determine possible relationships between autonomic responses, emotional factors and mental performance of students in actual classroom situations. From this kind of research there might be established specific classroom events or activities which evoke specific levels or degrees of arousal where learning of mental performance is best achieved.

There is need for continued research in emotions, values, attitudinal and physiological changes and their place in the educative process.

APPENDIXES

APPENDIX A

BIOGRAPHICAL AND OBSERVATIONAL DATA SHEET

Subject No.____, Date____________, Time______, Anxiety Score______

1. Name____
   School
2. Address____________________________________, Phone____________

3. Age______, Height______, Weight______, Classification__________

4. Are you now receiving any kind of medical treatment or taking any kind of drugs? ____________________________________

5. Have you ever had any kind of "heart trouble"?______________

6. Are you now engaged in any type of physical or athletic training?____

7. Do you smoke?_____, 1____, 2____, 3____, or more packs per day?

8. Do you eat 1 meal____, 2 meals____, 3 meals____, or more per day?

9. Do you sleep (average) 4-6____, 6-8____, or more than 8 hrs. per day?____

10. Do you usually feel "nervous" or excited when called upon to recite in class, or to give an oral report or when taking a quiz?____

*11. Have you experienced anything exciting or disturbing today?
____

*12. What did you do within the last hour? (e.g., physical activity, kinds and quantity of drinks or food taken, etc.)
____

APPENDIX A--Continued

A - N+

Classroom Occasion	Cardiac Rate (bpm)	$\bar{Y}$
Initial Rest		
Receiving 1st Speech Message		
Reciting		
Receiving Compliments		
Receiving Threats or Ridicule		
Receiving 2nd Speech Message		
Reciting		
Taking Quiz		
Rest		

Remarks:

*The subjects filled in items 1-10 prior to the recording session. The experimenter filled in items 11-12 immediately before or following electrode placement.

+The letter circled was the code for anticipatory (A) and non-anticipatory subjects (N).

APPENDIX B

GENERAL GUIDE FOR TEACHERS COOPERATING WITH THE RESEARCH

Subject's Name____

General: In order to assist in the maintenance of general tension, please do not mention to the class the fact that a particular student is actively participating in the research project.

TIME AND SEQUENCE OF CLASSROOM EVENTS AND THE TEACHER'S ROLE

Classroom Occasion (Subject's Disposition)	Teacher's Role during the Recording Session
Initial Rest: 10 min. or more	Carry on class as usual: e.g., lecturing, calling on other students to recite and commenting on their remarks, etc. (Ignore subject as much as possible.)
Receiving 1st Speech Message: 1-3 min. or less	Look directly at the subject and give the first speech message. (See below.) Call by name.
Reciting Extemporaneously 1-3 min.	Prod the subject to continue talking for at least one minute.
Receiving Compliments and Assurance: 1-3 min. or less	Direct complimentary remarks to the subject: e.g., Thank you, Mr. Doe; your contribution, along with others, helps to make the class a success. Furthermore, all of you are developing good habits of self expression.
Receiving Threats or Ricidule: 1-3 min. or less	Direct derogatory or threatening remarks to the class: e.g., I think you need to become more involved with what's going on in this class; or, the results of the last quiz were not all satisfactory; or, if you don't show more achievement, I will have to make greater demands of you.

APPENDIX B--Continued

TIME AND SEQUENCE OF CLASSROOM EVENTS AND THE TEACHER'S ROLE

Classroom Occasion (Subject's Disposition)	Teacher's Role during the Recording Session
Receiving 2nd Speech Message: 1-3 min. or less	Look directly at the subject. Call his name and give the second message. (See below)
Reciting Extemporaneously: 1-3 min. or less	Prod the subject to continue talking for at least one minute.
Taking Quiz: 5-8 min.	Direct students to prepare for a quiz. Pass out written quiz.
Rest: 10 min. or more	Collect papers. Carry on class as usual.

1st Message: Mr. Doe, tell us which psychological principle we have been studying interests you most and why.

2nd Message: Mr. Doe, give some of the psychological factors that shape personality.

APPENDIX C

Psychology 163

Test 1

Name ____

Directions: Draw a line through the letter corresponding to the correct answer.

1. Analysis of the way in which professional psychologists spend their working time has revealed that the largest percentage of time is devoted to:
   a. behavior modification
   b. teaching and training
   c. research
   d. assessment and evaluation

2. Classification in which the categories are not related to each other in a mathematical way is called:
   a. quantitative
   b. dimensional
   c. statistical
   d. qualitative

3. A theory is:
   a. a law of nature
   b. an orderly arrangement of observed facts
   c. a systematic statement of relationships between principles and facts
   d. a verified hypothesis

4. To study the "hippie" subcultural group of San Francisco, a psychologist would be most likely to use the:
   a. field-study method
   b. daybook method
   c. clinical method
   d. life-history method

Test 1--Continued

5. The control group is an experiment:
   a. differ as much as possible from the experimental group
   b. is not subjected to changes in the independent variable
   c. does not produce a dependent variable
   d. is given special training before hand

6. The clinical method of study:
   a. uses questionnaires to obtain information from a selected group
   b. makes direct observations of behavior under natural conditions
   c. keeps daily records of behavior and thought
   d. compiles information about emotional and personality adjustment in order to modify behavior

APPENDIX C

Psychology 163

Test 2

Name ____

Directions: Draw a line through the letter corresponding to the correct answer.

1. An individual's social stimulus value is essentially his:
   a. awareness of self as a permanent organizing force in his life
   b. pattern of measurable traits
   c. effect upon other people
   d. inner personality dimensions

2. Which type of explanation is least often used in psychology?
   a. deductive
   b. probabilistic
   c. teleological
   d. genetic

3. An idiographic personality theorist would be least likely to emphasize:
   a. functional explanation of behavior
   b. test scores as statistical variables
   c. the developmental history of the individual
   d. the uniqueness of each individual

4. "Faculties" located in specific areas of the brain were a central feature of:
   a. physiognomy
   b. somatotype theory
   c. graphology
   d. phrenology

Test 2--Continued

5. Studies have shown that judgments made on the basis of physiognomy:
   a. are more accurate for intelligence than for leadership ability
   b. correlate fairly highly with leadership ratings
   c. support the claim of somatotype theory
   d. show considerable agreement as to who looks like a leader

6. Kretschmer and Sheldon were leaders in the attempt to assess personality through study of:
   a. handwriting
   b. body types
   c. expressive behavior
   d. physiognomy

APPENDIX C

Psychology 163

Test 3

Name ____

Directions: Draw a line through the letter corresponding to the correct answer.

1. Studies of expressive behavior have shown that:
   a. voice prints show high correlations with certain personality traits
   b. Poor posture is often caused by inferiority feelings
   c. Persons high in dominance tend to have loud, resonant voices
   d. Posture is a more accurate indicator of personality traits than are facial characters

2. According to Freudian theory, the part of the personality which is continually called upon to make compromises is the:
   a. ego
   b. superego
   c. id
   d. libido

3. From samples of handwriting the graphologist is most likely to be able to indicate correctly the individual's:
   a. criminal tendencies
   b. attentiveness to detail
   c. persistence
   d. sex

4. In their study of personality, most clinicians:
   a. tend to rely more upon observation than upon experimental control
   b. use deductive explanations of behavior
   c. feel that theories of personality are unnecessary and premature at this stage in our knowledge
   d. are experts in statistical analysis

Test 3--Continued

5. During the early school years, according to Freudian theory, the individual is usually passing through the:
   a. anal period of personality development
   b. phallic-oedipal stage
   c. latency period
   d. genital period

6. According to Freudian theory, an excessively neat, tidy miser probably did not:
   a. have enough opportunity for sucking as an infant
   b. have sufficient satisfaction for his cravings during the anal period of his development
   c. succeed in resolving the phallic-oedipal conflict
   d. become emotionally emancipated from his parents during the genital period of development

APPENDIX C

Psychology 163

Test 4

Name ____

Directions: Draw a line through the letter corresponding to the correct answer.

1. According to neo-Freudian Karen Horney, basic anxiety is the result of:
    a. conflict between the id and the superego
    b. conflict between conscious and unconscious desires
    c. failure to pass through all the stages of personality development
    d. insufficient love and security in childhood

2. According to Erich Fromm, everyone has a need for transcendence; this means that he feels a need to:
    a. relate to other people in a satisfying way
    b. control his animal nature
    c. find a clear identity
    d. find a frame of orientation

3. As compared to psychoanalytic theory, analytical psychology places greater emphasis upon:
    a. goals and aspirations
    b. unconscious wishes
    c. the satisfaction of instincts in various ways
    d. very early experiences

4. Archetypes are:
    a. phenomenal fields
    b. measures of self-actualization
    c. racial memories
    d. psychosocial crises

5. According to Adler, man's most basic motivation is:
    a. drive toward self-actualization
    b. satisfaction of instinctive desires of a broadly sexual nature

Test 4--Continued

   c. striving for superiority
   d. need to overcome basic anxiety

6. According to Adler, in striving for his most basic goal each person develops his own:
   a. archetypes
   b. phenomenal field
   c. frame of orientation
   d. life style

APPENDIX C

Psychology 163

Test 5

Name ______________________________

Directions: Draw a line through the letter corresponding to the correct answer.

1. The field theory concept of the physical sciences had the most direct influence upon:
   a. Adler's individual psychology
   b. Goldstein's organismic theory
   c. Jung's analytical psychology
   d. stimulus-response theories of personality

2. Which of the following does not emphasize self-actualization as the primary goal of the personality:
   a. organismic theory
   b. existentialism
   c. stimulus-response theories
   d. the theory of Maslow

3. The personality theory which places the greatest emphasis upon man's absolute freedom and responsibility to make wise choices is:
   a. existentialism
   b. organismic theory
   c. analytical psychology
   d. dyadic theory

4. According to Miller and Dollard, neurotic conflicts stem from:
   a. failure to achieve self-actualization
   b. contradictory cultural demands
   c. wrong choices early in life
   d. discrepancies between unconscious desires and the self concept

Test 5--Continued

5. Robert R. Sears differs from the other stimulus-response personality theorists primarily in his greater emphasis upon:
   a. dyadic units
   b. solution learning
   c. experimental methods
   d. very early infancy

6. The greatest weakness of the personal interview as used in industry and clinical work stems from:
   a. the halo effect
   b. faulty memory
   c. failure to sum up judgments concisely and objectively
   d. the use of stereotypes

APPENDIX C

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Test 6

Name ____

Directions: Draw a line through the letter corresponding to the correct answer.

1. The standard interview can be of most value in overcoming which weakness of the personal interview:
   a. faulty memory
   b. stereotypes
   c. the halo effect
   d. failure to quantify

2. Studies of the value of the Rorschach test have shown that it:
   a. is a valuable aid in predicting the success of management personnel
   b. can readily discriminate between normal, neurotic, and psychotic individuals
   c. is valuable chiefly for predicting how patients are likely to react to treatment in psychiatric clinics
   d. has shown disappointing results in most areas in which it has been used

3. Schizophrenic cases can most readily be identified through the use of which projective technique:
   a. Rorschach test
   b. Kahn Test of Symbol Arrangement
   c. Thematic Apperception Test
   d. Incomplete Sentences Blank

4. A major limitation of projective tests is that they:
   a. reveal only superficial personality characteristics
   b. are not sufficiently objective
   c. are readily subject to faking
   d. are difficult to use with mental patients

Test 6--Continued

5. Studies of the value of the Thematic Apperception Test have shown that it:
   a. is of considerable value in predicting vocational success
   b. is effective in detecting creativity
   c. can give insight into differences among various ethnic groups or age groups
   d. is of no value on personality study

6. Ease of administration and scoring is a characteristic of:
   a. the Kahn Test of Symbol Arrangement
   b. the Rorschach test
   c. the Thematic Apperception Test
   d. none of the projective techniques

APPENDIX D

BIOGRAPHICAL INVENTORY
(Taylor's Manifest Anxiety Scale)

a. Name_______________________________________ Sex:__________
School
b. Address________________________________ Phone____________

c. Age_____, Height________, Weight_______, Classification______

d. Are you now receiving any kind of medical treatment or taking any kind of drugs?__________________________________

e. Have you ever had any kind of "heart trouble"?______________

f. Are you now engaged in any type of physical or athletic training?__________________________________

g. Do you smoke?_____, 1_____, 2_____, 3_____, or more packs per day?

h. Do you eat 1 meal_____, 2 meals_____, 3 meals_____, or more per day?

i. Do you sleep (average) 4-6_____, 6-8_____, or more than 8 hrs. per day?

j. Do you usually feel "nervous" or excited when called upon to recite in class, or to give an oral report or when taking a quiz?__________________________________

Directions--This biographical inventory contains fifty questions which will provide reference in the study of autonomic arousal. Please answer all questions frankly and truthfully by writing the word true or false opposite the respective number.

Never pass over an item but give an answer to every single one. Your answer will be entirely confidential.

APPENDIX D--Continued

Do not spend time pondering. Answer each immediately the way you want to at this moment (not last week, or usually). You may have answered questions like this before, but answer them as you feel now.

_______1. I do not tire quickly.

_______2. I am often sick to my stomach.

_______3. I am about as nervous as other people.

_______4. I have very few headaches.

_______5. I work under a great deal of strain.

_______6. I cannot keep my mind on one thing.

_______7. I worry over money and business.

_______8. I frequently notice my hand shakes when I try to do something.

_______9. I blush as often as others.

_______10. I have diarrhea ("the runs") once a month or more.

_______11. I worry quite a bit over possible trouble.

_______12. I practically never blush.

_______13. I am often afraid that I am going to blush.

_______14. I have nightmares every few nights.

_______15. My hand and feet are usually warm enough.

_______16. I sweat very easily even on cold days.

_______17. When embarrassed I often break out in a sweat which is very annoying.

________ 18. I do not often notice my heart pounding, and I am seldom short of breath.

________ 19. I feel hungry almost all of the time.

________ 20. Often my bowels don't move for several days at a time.

________ 21. I have a great deal of stomach trouble.

________ 22. At times I lose sleep over worry.

________ 23. My sleep is restless and disturbed.

________ 24. I often dream about things I don't like to tell other people.

________ 25. I am easily embarrassed.

________ 26. My feelings are hurt easier than most people.

________ 27. I often find myself worrying about something.

________ 28. I wish I could be as happy as others.

________ 29. I am usually calm and not easily upset.

________ 30. I cry easily.

________ 31. I feel anxious about something or someone almost all of the time.

________ 32. I am happy most of the time.

________ 33. It makes me nervous to have to wait.

________ 34. At times I am so restless that I cannot sit in a chair for very long.

________ 35. Sometimes I become so excited that I find it hard to get to sleep.

________ 36. I have often felt that I faced so many difficulties I could not over come them.

________ 37. At times I have been worried beyond reason about something that really did not matter.

_______38. I do not have as many fears as my friends.

_______39. I have been afraid of things or people that I know could not hurt me.

_______40. I certainly feel useless at times.

_______41. I find it hard to keep my mind on a task or job.

_______42. I am more self-conscious than most people.

_______43. I am the kind of person who takes things hard.

_______44. I am a very nervous person.

_______45. Life is often a strain for me.

_______46. At times I think I am no good at all.

_______47. I am not at all confident of myself.

_______48. At times I feel that I am going to crack up.

_______49. I don't like to face a difficulty or make an important decision.

_______50. I am very confident of myself.

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