AN ABSTRACT OF THE THESIS OF

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Title: Meditation and Relaxation and Their Effect Upon the Pattern of Physiological Response During the Performance of a Fine Motor and Gross Motor Task

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The purpose of this study was to determine the effect of immediate prior meditation (transcendental meditation) and relaxation upon the pattern of physiological response and performance of a fine motor and gross motor task. A second purpose of this study was to determine whether the long term regular practice of a passive meditation technique (TM) produces a difference in the reaction to motor activity.

A pretest-posttest control group randomized blocks design was used in this study. Sixteen transcendental meditators with three or more years regular practice were selected as the meditation group. Subjects with no history of relaxation training were recruited and 16 nonmeditators were selected to create matched pairs with subjects in the meditation group. Matching criteria were: sex, age, height, weight, current and customary activity level. Each matched pair of subjects

was assigned to one of two groups with an attempt to balance matching criteria for each group. One group was randomly assigned to experimental procedures, the other group served as a control group.

Subjects performed pre and posttests on a pursuit rotor task and a bicycle task while being monitored for heart rate, blood pressure and frontalis EMG. Experimental subjects meditated (meditation group) or relaxed with eyes closed (nonmeditation group) immediately prior to the posttest.

Analysis of variance of trends was used to test the first hypothesis which dealt with the pattern of physiological response to the tasks. Analysis of variance was used to test the second hypothesis which dealt with the level of performance of each of the two tasks. A multiple regression analysis was used to test the third hypothesis which dealt with the relationship between performance and physiological response.

Results showed no significant difference between experimental and control groups of meditators and nonmeditators in the pattern of physiological response, the level of performance, or the relationship of performance and physiological response to a fine motor or gross motor task.

Meditation and Relaxation and Their Effect Upon the Pattern of Physiological Response During the Performance of a Fine Motor and Gross Motor Task

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CHAPTER I

INTRODUCTION

Stress, as a component of living, has been the concern of many with regard to its impact on human performance and health. A multitude of relaxation techniques have been employed in an effort to reduce the impact of acute and chronic stress.

The psychophysiological changes that occur during meditation and the quality of task performance of meditators have interested many researchers. Recent investigations have dealt with the practice of passive forms of meditation as techniques for reducing stress reactivity, but none have addressed meditation as a technique for reducing the physiological reaction produced during motor activity. This study will address itself to meditation and relaxation and their effect upon the pattern of physiological response during the performance of a fine motor and gross motor task.

Purpose of the Study

The purpose of this study was to determine the effect of immediate prior meditation (transcendental meditation) and relaxation on the pattern of physiological response and performance of a fine motor and gross motor task. A second purpose of this study was to determine whether the long term regular practice of a passive meditation technique (TM) produces a difference in the reaction to motor activity. Experienced transcendental meditators and subjects with no history of practice of a relaxation technique were compared.

Significance of the Study

Numerous studies have investigated the physiological changes which occur during the practice of a transcendental meditation (TM) (Allison, 1970, Jevning, et al, 1977; Wallace, 1970; Wallace and Benson, 1972), few have investigated physiological changes during stress (Goleman and Schwartz, 1976). A relaxation technique should enable an individual to reduce tension as determined by physiological measures during the practice of that technique. Equally valuable is the property of carryover so that tension continues at a reduced level in activity, or that habituation to stress is facilitated. The importance of the maintenance of reduced tension and increased habituation is that the stress response is not then maintained without need (Folkow, 1971; Selye, 1973; Stoyva, 1976), and muscular tension is localized and efficient for the task at hand (Freeman, 1931; Gregg, 1942).

This study investigated the effect of immediate prior meditation and relaxation on two levels of motor activity and whether the long term regular practice of a passive meditation technique (TM) produced a difference in the physiological reaction to motor activity.

Hypotheses

Several research questions were of concern in this investigation. From these concerns the following null hypotheses were developed and tested. Three main hypotheses were identified. Further defined are two dubhypotheses under each main hypothesis. All hypotheses were tested at the .05 level of significance.

1. No significant difference exists between meditators and nonmeditators in the pattern of physiological response to a fine motor and gross motor task.

    1.1 No significant difference exists in the pattern of physiological response between subjects who have relaxed and subjects who have not relaxed immediately prior to a pursuit rotor task.

1.2 No significant difference exists in the pattern of physiological response between subjects who have relaxed and subjects who have not relaxed immediately prior to a bicycle task.

2. No significant difference exists between meditators and nonmeditators in the performance of a fine motor and a gross motor task.

2.1 No significant difference exists in the levels of performance between subjects who have relaxed and subjects who have not relaxed immediately prior to a pursuit rotor task.

2.2 No significant difference exists in the levels of performance between subjects who have relaxed and subjects who have not relaxed immediately prior to a bicycle task.

3. No significant difference exists between meditators and nonmeditators in the relationship between performance and physiological response to a fine motor and a gross motor task.

3.1 No significant difference exists in the relationship between performance and physiological response between subjects who have relaxed and subjects who have not relaxed immediately prior to a pursuit rotor task.

3.2 No significant difference exists in the relationship between performance and physiological response between subjects who have relaxed and subjects who have not relaxed immediately prior to a bicycle task.

Methodology Statement

Subjects included 16 transcendental meditators (meditation group) whose regular practice of the TM technique was three years or more and 16 subjects with no history of practice of a relaxation technique (non-meditation group) who were matched as closely as possible with individuals in the meditation group, creating matched pairs. Matching variables included: sex, age, height, weight, and current and customary activity level. Each matched pair of subjects was assigned to one of two subgroups. Matched subgroups were randomly assigned to experimental or control conditions. All subjects were volunteers and signed an Agreement to Participate form (Appendix A).

Each subject performed five one-minute trials (Eason and White, 1960) of a pursuit rotor task, followed by performance of the Luft (1963) bicycle ergometer protocol to a target heart rate of 70% age predicted maximum (Appendix E). Experimental subgroups performed a posttest of the pursuit rotor and bicycle tasks immediately following a meditation/relaxation period.

Subjects were measured for heart rate, blood pressure and frontalis EMG prior, during and following the pursuit rotor and bicycle tasks. Time on target pursuit rotor scores for each trial and length of performance time to a pre-established target heart rate on the bicycle were also recorded.

Laboratory Site

All testing was conducted in Room 124 Moreland Hall, Oregon State University. This room contained a shielded room which could be darkened for the meditation/relaxation period.

Research Team

Two female assistants were used for data collection. One was trained in taking blood pressure, the other trained in operating the EMG Dual Processor and Time Period Integrator.

Assumptions

The following assumptions were made in this investigation:

1. Subjects were able to meditate/relax in the

structured environment of the laboratory.

2. Transcendental meditation is a relaxation technique.
3. Matched pairs of meditation and nonmeditation subjects were equivalent except for the variable of meditation history.
4. Blood pressure was taken reliably while the subject was pedalling the bicycle ergometer.

Limitations and Delimitations

The study was limited to 16 transcendental meditators who have practiced the TM technique regularly for three or more years, and a nonmeditation group of 16 Oregon State University students who have no history of practice of a relaxation technique, and who were matched as closely as possible with the meditation group for sex, age, height, weight, and current and customary activity level during Winter term, 1979. Generalizations from this study are not made regarding transcendental meditators who have irregular practice or less than three years of regular practice. Although some subjects had advanced training in TM, conclusions were not drawn regarding the short or long term effects of such training. The population of meditators was from the Corvallis, Oregon area with the exception of one Portland, Oregon resident and results were not generalized to all transcendental meditators. An assumption was made that the pairs of meditation and nonmeditation subjects were validly matched, however variations may exist between groups which are not accounted for in the matching criteria.

Subjects, especially the transcendental meditators in this study, may have tried to control their physiological response in an effort to look good. Biofeedback research indicates physiological variables can be consciously controlled. It is also possible for a subject to produce the opposite of his or her desired result in the effort to control physiological variables. The technique of TM is characterized by its effortlessness. Any attempt by the subject to try to meditate or control physiological response during meditation would be incompatible with producing the meditative state. Although subjects were reminded of the importance of being as natural and normal in their response as possible, not trying to make any effort to be "good", some subjects may have found the opportunity of the experiment distracting and normalcy difficult to achieve.

The experiment measured only frontalis EMG, heart rate and blood pressure as physiological variables. It is recognized that physiological variables in addition to those selected for measure in this study, eg. GSR, EEG, may have provided significant data expanding and clarifying further the pattern of physiological response to motor activity.

Taking blood pressure with a pressure cuff around the arm may create sufficient stress to alter the heart rate, frontalis EMG and blood pressure itself, and may have had an impact on subject response.

The performance measure for the pursuit rotor task was time on target scores for each of five one-minute trials. Fewer or greater trials and longer or shorter time intervals during and between trials may have affected the performance and may have produced a different pattern of physiological response.

Length of performance time taken to reach a pre-established heart rate was the measure of performance for the bicycle task. To provide reasonable cardiovascular stress without promoting the risk of critical cardiac overload, a 70% age predicted maximum heart rate was chosen for the target heart rate. It is recognized that patterns of physiological response may alter when exhaustion is near or is reached. Subjects may have performed to different work loads before reaching their target heart rate and variables may have existed not tested in this study. A gross motor cardiovascular stress instrument such as a treadmill with less dependency on leg strength and leg endurance for performance may have provided different results but was not feasible for this study.

The effects of testing during different parts of the term in which subjects may be under varying degrees of academic stress could be considered. During the first part of each session the subject was asked how their day went, how they felt, with particular attention paid to any extra stresses that may be influencing their lives at that particular time. The information was noted.

The number of subjects used in this study was limited to eight per group, and due to the design and subjects used in this study, results may not reflect patterns which may have emerged if larger groups had been tested.

Definitions

The following are definitions of terms relevant to this study:

Fine motor task is defined as a task which requires eye-hand coordination and precise movement of localized muscles.

Gross motor task is defined as a task which requires the movement of large muscle groups and which provides sufficient work to tax the cardiovascular system.

Meditation group is a group of 16 transcendental meditators who have regularly practiced the TM technique for three or more years.

Meditation period is the treatment period in which subjects in the meditation group assigned to the experimental procedures practiced the TM technique for 15 or 20 minutes, depending on personal customary practice.

Nonmeditation group is a group of 16 Oregon State University students who have no history of practice of a relaxation technique and who are matched as closely as possible with the meditation group for sex, age, height, weight, and current and customary activity level.

Pattern of physiological response is determined by the changes in repeated measures of selected physiological variables over time.

Relaxation period is the treatment period in which subjects in the nonmeditation group assigned to the experimental procedures sat and relaxed with eyes closed for a corresponding length of time to their matched meditator.

Transcendental meditation is as defined in the Review of Related Literature, page 12.

CHAPTER II

REVIEW OF RELATED LITERATURE

A review of pertinent literature related to relaxation, meditation, tension and performance is presented in this chapter. The nature of physiological and psychological variables and performance are discussed. Further discussion considers the technique of transcendental meditation, the physiological and psychological correlates of TM, and the effect of meditation on performance. The criterion motor performance tasks and physiological measures in this study are reviewed with respect to their specific application. A summary is included at the end of this chapter.

Transcendental meditation (TM) is a widely practiced, standardized technique of a passive type of mantra meditation taught by Maharishi Mahesh Yogi. Mantra is a Sanskrit term and denotes a sound, which in the case of TM, is produced as an "auditory image" and is passively "listened to" for 15 or 20 minutes. In this way the meditator "turns the attention inward towards the subtler levels of a thought until the mind transcends the experience of the subtlest state of thought and arrives at the source of thought." (Yogi, 1966, p. 409).

The physiological changes which occur as a result of TM are not the result of conscious controlling. A number of studies have shown that conditioning can alter autonomic functions and the electrical activity of the brain (Budzynski and Stoyva, 1969), but in TM the physiological changes reported to occur are as by-products of the mental experience (Goleman and Schwartz, 1976).

Many forms of passive meditation have been shown to produce similar results, however, a conflict seems to prevail as to whether a "thoroughly consistent replicated pattern of responses" to passive meditation has been demonstrated (Otis, 1974; Goleman, 1977; Woolfolk, 1975-76).

In understanding the mechanisms of various meditative techniques, the findings reflect influences of very complex sets of social, cognitive, perceptual and physiological variables which increase the difficulty of research. The effect of any form of relaxation would also include such variables. Understanding the mechanisms of relaxation can lead to the development of a counter to the stress mechanisms which are reflected in changes in the psychophysiological response and performance of tasks.

Theories of Tension and Health

Mobilization of Tension

The function of the fight or flight response, as proposed by Cannon (1932), is to mobilize the body's resources for swift action. During the fight or flight response the heart beats more rapidly, more blood is circulated, stored sugar is released from the liver, respiration deepens, and the sympathetic nervous system is activated.

Stress may be thought of as the "excess maintenance tension" resulting from a problem situation created by a disequilibrium in the environment (Howard, 1965). A problem is regarded as "any condition which is posed to an individual for solution". Stress can be the result of cognitive appraisal, can be on the conscious or subconscious level of action, result from a variety of environmental stimuli, and be the result of a failure to master a problem solving situation. Howard (1965) states, "No organism ever attains a state in which all its problems are solved. Rather, every person exists under conditions in which some problems are under control, others are being dealt with, and still others may be temporarily ignored." (p. 150).

Response Stereotypy

Cognitive appraisal is critical in determining whether a stress response will be elicited (Lazarus, 1966; Malmo, 1972; Mason, 1972; Stoyva, 1976). Each individual is unique in their perception, appraisal and reaction to a situation. The same situation may produce different physiological reactions a different times if the individual perceives the situation as being more or less stressful one time than another.

For a given set of autonomic functions, individuals tend to respond with an idiosyncratic pattern, in which no matter what the stress, the same physiological function shows maximal activation. Individuals can be characterized as "blood pressure reactors", "stomach reactors", "nose reactors" (Patel, 1977). This pattern of response is reproducible over different sutuations involving stress (Lacey and Lacey, 1958). Reproducibility of some measures of the autonomic response stereotypy is greater than others. Salivary secretion has the highest reliability according to Lewinsohn (1956). Skin resistance, on the other hand, was found to be the most independent and most reproducible by Lacey and Lacey (1958). Heart rate and heart rate variability have been found almost equally as independent, and blood pressure has shown consistent significant intercorrelation in a complex fashion (Lacey and Lacey, 1958). No single physiological measure, however, correlates well with others or can serve as an index to the state of other measures or to the "total arousal of the organism" (Lacey and Lacey, 1962, Lewinsohn, 1956).

Lader (1970) concurs with Lacey and Lacey (1958) in a study comparing methods of relaxation. Variability was found in and among physiological measures within subjects. Normal subjects showed a low degree of response stereotypy; psychosomatic patients, on the other hand, show a high degree of response stereotypy (Sternbach, 1966).

Four levels of response stereotypy are discussed by Lacey and Lacey (1958). Situational stereotypy is the modal response pattern to a specific situation. Intra-stressor stereotypy is the reproducible pattern of responses to a single form of stressor. If reproducible over different stressors, it is termed inter-stressor stereotypy. Finally, symptom stereotypy refers to the constancy of the physiological measure in which the area of maximal activation to stressful experience is in line with the complaint given by patients with psychosomatic disorders (Lacey and Lacey, 1958).

Deep physiological relaxation, then, is not simply a low frontalis EMG, or a low heart rate or low blood pressure, but a combination of such changes (Schwartz, 1975). The most effective relaxation technique may depend on the type of anxiety the person is experiencing at the time and the person's autonomic response stereotypy (Schwartz, 1975).

Meditation represents a complex pattern of which deep relaxation is only one pattern within the complex (Schwartz, 1976). A major effect of transcendental meditation is to produce a unique pattern of cortical versus limbic system arousal (Wallace and Benson, 1972). Mantra meditation can lead to heightened cortical and reduced limbic arousibility at the same time according to Schwartz (1976).

Stress Linked Disorders

Sternbach (1966) has reported a model for thinking about stress related disorders. A combination of factors are required in order for a stress-linked disorder to develop:

1. A response stereotypy.
2. Frequently occuring stresses which trigger the

response stereotypy, and are frequent enough to prevent a return to baseline.

3. This in turn triggers a failure in the homeostatic mechanisms, and pressures remain constantly elevated.

Considerable evidence is available demonstrating that daily living habits and one's habitual response to stress figure prominently in heart disorders, eg. high levels of animal fats in the diet, heavy tobacco usage, lack of exercise and continued emotional stress (Stoyva, 1976). The body, specifically the pituitary adrenal cortical system, responds hormonally in a "non specific" manner to many different stimuli, eg. excessive muscular exercise, trauma, cold, fasting, acute infections (Selye, 1956).

Cardiovascular Response

Cardiovascular responses represent adjustments to meed metabolic requirements, potentially or actually demanded. Only a limited number of basic response patterns involving cardiovascular variables may exist, activated by a certain set of sufficient stimuli. Some situations may result in more than one basic response pattern (Cohen, 1975). Cardiovascular learning then can be viewed as a mechanism for expanding the choices of stimuli for any given response pattern so that the pattern can occur in anticipation of events (Cohen, 1975).

Heart rate is a good indicator of overall somatic activity according to Obrist, et al (1970). A common central nervous system mechanism is seen to control both heart rate and somatic activity creating a "coupling effect". "Decoupling" occurs at highly aversive or stressful situations (Obrist, et al, 1970).

If the stress response is evoked too often or sustained too long, disorders are likely to develop (Folkow, 1971; Selye, 1956, 1973; Simeons, 1962; Stoyva, 1976; Wallace and Benson 1972; Wolf and Goodell, 1968). Cardiovascular pathology develops less from intense repeated demand than from cardiovascular adjustments without accompanying metabolic demand (Cohen and Obrist, 1975). Symptom specificity (Goldstein, 1964), results from repeated production of unused preparatory tension in particular responding muscle groups or autonomic areas.

Relaxation Response

The relaxation response described by Benson, et al (1974) appears to be an integrated hypothalmic response which results in a generalized decrease in sympathetic activity, and perhaps also an increase in parasympathetic activity. This response is first described by Hess (1954) as the trophotropic response as opposed to an ergotropic or "fight or flight response" (Cannon, 1932). In a discussion of the physiology of neuromuscular relaxation, Gellhorn (1958) indicates the excitability of the sympathetic division of the hypothalmus can be diminished by increased discharges of baroreceptors in the sino aortic area and by reduction in proprioceptive impulses coming to the hypothalamus. Reduction in hypothalamic activity is also accompanied by reduced excitation in the cerebral cortex, emotional activity, and the tendency for subjects to fall asleep.

The ergotropic syndrome, according to Hess (1954) consists of an increase in sympathetic discharges and skeletal muscle tone, and a diffuse cortical excitation, (desynchronization of EEG potentials as in awakening). The trophotropic syndrome is typified by increased parasympathetic discharges, relaxation of skeletal muscles and lessened cortical excitation (increased synchrony as in sleep) (Hess, 1954; Gellhorn and Kiely, 1972).

"The physiological change which accompanies the mental state of meditation is a shift in the trophotropic-ergotropic balance to the trophotropic side," reports Gellhorn and Kiely (1972, p. 400). The EEG patterns in states of passive meditation indicate that conditions reflective of trophotropic dominance are compatible with full awareness as reported by meditators (Wallace, et al, 1971).

Muscle Relaxation

EMG changes are related to many stressful environmental events (Malmo, 1966). Deep muscle relaxation is utilized in many therapies because it is said to be incompatible with the presence of anxiety (Budzynski and Stoyva, 1969). Malmo (1948) reports that surface EMG is a reflection of motivation or level of activation.

The frontalis muscle was chosen by Haynes, et al (1975-76) as a measure to compare relaxation techniques. Previous research had suggested it may be correlated with tension levels in other areas of the body and with other indices of autonomic arousal such as heart rate and skin resistance (Jacobsen, 1970; Sainsbury and Gibson, 1954; Stoyva and Budzynski, 1974). The frontalis muscle is reported to be one of the most difficult muscles to relax (Balshan, 1962; Stern and Berrenberg, 1977; Stoyva and Budzynski, 1974).

EFFECTS OF TENSION ON HEALTH

Cardiovascular Response

Tension produces a number of physiological changes. Several studies have investigated the effects of tension on heart rate, blood pressure and frontalis EMG. Various relaxation techniques have also been explored to determine their effect on such physiological measures.

That environmental events of a stressful nature produce cardiovascular responses hardly requires documentation (Cohen, 1975). The heart rate and blood pressure may rise in anticipation of a stressful encounter. Heart rate was chosen as a variable in a study by Sirota, Schwartz and Shapiro (1974) because of its association with fear. According to Brod (1963, as reported in Cohen and Obrist (1975)), discrepancies between anticipatory cardiovascular adjustments and metabolic demand occur most often in situations in which the individual is given an opportunity to avoid the stressful stimuli by an overt act.

In comparison of general relaxation suggestions and hypnotic induction, Burns (1971) found differing responses to induced anxiety. Heart rate response was higher for the general relaxation group. Sirota, Schwartz, and Shapiro (1974) reported that subjects who voluntarily slowed their heart rate reduced their perceived aversiveness of a stimuli. This was particularly so in those subjects who reacted cardiacally to fear situations in daily life.

Blood Pressure Response

Edelman (1970) found that progressive muscle relaxation does reduce blood pressure. However, the technique of progressive muscle relaxation was not unique. Controls who were told to relax produced the same results. Fidel (1977) found that subjects using a biofeedback relaxation technique reduced both systolic and diastolic blood pressure. Controls using a general relaxation technique reduced only diastolic blood pressure. Fidel also noted there was much variation among subjects in both groups.

Patel (1977) trained hypertensive subjects in a biofeedback aided relaxation and meditation technique and found a quicker recovery of blood pressures to baseline levels after exposure to a standard laboratory stressor than controls who had not been taught the technique.

Muscle Relaxation

Haynes, et al (1975-76) examined five different relaxation techniques and their effectiveness in reducing frontalis muscle tension. The passive relaxation technique of Wolpe's systematic desensitization was found to reduce frontalis EMG the best.

Working with athetoid cerebral palsy patients, Finley, et al (1976) found frontalis EMG biofeedback aided in the improvement of fine and gross motor functions. This suggests the use of frontalis muscle training as a general body relaxation focus.

Freedman and Papsdorf (1976) found no significant relationship between physiological levels (heart rate, frontalis EMG, and EEG) and sleep onset time in insomniacs. Since subjects did improve, this suggests that muscle relaxation alone was not responsible for the improvement. No difference was found between the effectiveness of the techniques of progressive muscle relaxation and biofeedback. Good (1975) previously found that waking frontalis EMG level did not predict sleep latency, indicating no threshold had to be reached before sleep could begin. The question was raised in conclusions regarding the use of muscle relaxants and relaxation training to facilitate the onset of sleep.

THEORIES OF TENSION AND PERFORMANCE

Efficiency and skill in human movement is demonstrated in selectivity of motor unit innervation. The poorest performers have the greatest muscular tension (Duffy, 1932), coordination being dependent on the ability to inhibit reactions. A record of the tonus in a remote muscle group indicates the "spread" of muscular tension in an activity (Freeman, 1933).

Levels of Tension and Performance

Tension has been shown to be inhibitive and facilitative depending on a variety of factors. Bills, et al (1937) describes two kinds of tension; emotional upset, which is felt to be inhibitive, and effort, which facilitates performance. An optimum level of tension appears to facilitate performance (Courts, 1939; Freeman, 1938). This tension is not the same for all kinds of activities. Simple tasks are facilitated by tension more than complex ones. Orientation to the task also varies the tension. Subjects who are working for accuracy have a decrease in tension; working for speed increases the tension (Gheselli, 1936). Extreme degrees of tension have been found to interfere with performance (Freeman, 1933).

<u>Muscular Work and Tension</u>

Muscular work is accompanied by an increase in muscular tension (Davis, 1939; Freeman, 1931). At the onset of work an initial increase in tension is shown which rapidly drops down to a level somewhat above that of rest (Davis, 1939). Muscular tension is perceived by some to be a state of alertness or preparedness (Duffy, 1932). The height of the initial rise is a function of the subject's "set" (Freeman, 1931, 1933).

An inverted U shaped curve is typical of the relationship between learning and the degree of experimentally produced tension (Courts, 1942). Davis 1937, 1939) found no evidence for a consistent relationship between output of work and muscle action potential. A "peripheral theory of psychological process", therefore, demands a correlation between psychological process and muscular phenomena rather than between work output and muscular phenomena (Courts, 1942).

Some anxiety patients display an excessive bodily response to exercise. Jones and Mellersh (1946) studied patients with "effort syndrome" whose intolerance to effort produced somatic symptoms on exertion in excess and for no apparent reason except anxiety. Using a 10 minute recovery period, Jones and Mellersh (1946) suggested the use of "pulse area" for comparisons of exercise response. Pulse area is described as the sum of the recovery pulse for minutes one through four plus the mean of minute eight through ten, subtracting five times the resting pulse.

After moderate or severe physical exercise, a characteristic curve for heart rate is obtained in which the maximum decrease occurs within the first four minutes and then flattens out rapidly (Jones and Mellersh, 1946).

Effort and Tension and Performance

Tension level of muscles of the head, neck, shoulder and arm regions have been reported to reflect the relative amount of effort exerted during the performance of various physical and perceptual motor tasks (Eason, 1963). Eason, (1963) reported an experiment in which EMG levels were used to assess how well a subject performed a task relative to the amount of effort exerted. This "index of performance efficiency" was determined by a ratio of performance quality to tension level. The amount of effort based on the EMG of the neck muscle) was found to be independent of skill. The performance efficiency ratio varied with incentive, length of continuous work and degree of skill (Eason and Branks, 1963). Studies dealing with the relationship between muscular tension level and performance quality have yielded highly variable results (Eason and Branks, 1963).

In a study of three years olds, Duffy (1932) reported that fluctuations in tension were at least as closely related as degree of tension to performance. Irregularities in tension, concluded Duffy, are indicative of the degree of coordination which is in turn dependent on the ability to inhibit reactions and selectively relax musculature.

Duffy (1932) proposed a two dimensional hypothesis relating tension and performance. Behavior varies along two continua: direction and intensity. The relationship between tension level and performance is dependent upon the direction in which the subject exerts his effort as well as the intensity of that effort (Eason, 1963). The muscular tension is also positively related to both motivation which facilitates performance, and to muscular fatigue which is detrimental to performance. Tension level at any given time is the summation of the motivational and fatigue components (Eason and White, 1960).

Habituation

The level of activity of non involved musculature becomes less with practice (Davis, 1937). This has been termed "habituation" (Davis, 1937). Eason (1963), using a pursuit rotor task, reported that for each daily session neuromuscular control increased from trial to trial while neck tension level decreased. Tension becomes more localized in the reacting musculature as work progresses (Freeman, 1931; Gregg, 1942). Therefore, at the beginning of successive periods of similar activity the extraneous muscular tension would tend to be progressively less.

Anticipation

In a study of temporal factors in stress reactions, Folkins (1970) found a one-minute anticipatory time most stressful. Shorter or longer periods were better especially if cognitive coping could occur. Responses taken at 10 second intervals was recommended by Folkins (1970).

Dean (1966) reports, "If S is told exactly when shock is to be received, deceleration effect (of heart rate) appears immediately." (p. 195). Folkins (1970) suggests lengthy recovery periods to study the deceleration of heart rate.

Frontalis EMG

Darwin (1872) hypothesized that the facial expressions of emotions can be differentiated and are universal. Izard (1971) found significant the relationship of facial specific patterns of muscle tension to the subjective experience of emotion. This was supported by Schwartz, et al (1974).

Frontalis EMG has been reported in a number of studies measuring muscle tension. Controversy exists as to the efficacy of the frontalis as a measure of general body relaxation. According to Basmajian (1976), the electrode placement for the frontalis muscle reflects swallowing, breathing, movements of the jaws, tongue, eyes, and all sorts of repeated dynamic muscular activity along with nervous tension overactivity. Frontalis EMG was used by Budzynski and Stoyva (1969, 1974) as a general relaxation measure. The use of the frontalis is supported by Sainsbury and Gibson (1954) and Haynes (1975-76) who report correlations with tension in other areas of the body and with other autonomic measures such as heart rate and GSR.

The reliability of various estimates of electromyographic activity was examined by Epstein and Webster (1975). Cumulative integration values were stressed as necessary for precise estimates of within subject changes. For group activity a derived EMG measure was suggested. Reliability also varied with length of time. The within subjects scores were more variable using one minute time periods, however between subject scores were most reliable at one minute time periods.

EFFECTS OF TENSION ON PERFORMANCE

Various forms of relaxation techniques designed to reduce tension have been shown to affect performance of physical and mental tasks. Jacobsen's (1938) instructions in relaxation, for instance, enabled subjects to perform better on mental tests than controls in a study done by Chaney (1972).

Relaxation Techniques and Performance

Induced laboratory stress has been used to test the effectiveness of relaxation techniques. Lazarus (1968) cited evidence some stressful stimuli are of such a nature as to never fully habituate, however often the stimuli is repeated. To the stressor film used by Lazarus (1968), Davidson, et al (1971) did find both telling the subject to relax and giving relaxation instructions did reduce physiological arousal (GSR) over repeated exposures to the film, disagreeing with Lazarus' assumption the stress of the film would never fully habituate.

Gatchel, et al (1978) found that a biofeedback group maintained a low level of frontalis EMG during stress. No generalizations were found, however, to other physiological measures.

Levels of Tension and Performance

Krause (1977) studied the effects of anxiety and activation on athletic performance and concluded anxiety does differentially affect athletic performance based on varying demands of the tasks involved. This context would relate to both state and trait notions of anxiety, and complexly relate autonomic measures such as heart rate to anxiety, activation and game performance.

Detrimental effects of extremely high levels of tension prior to and during physical activities involving endurance has been generally accepted (Nideffer, 1970). Not well established is the effect of tension if the activity involves intense effort for a brief period. A shot putter was reported to have improved in distance (after a seeming limit had been reached) after two weeks of relaxation practice (Nideffer, 1970). Practice at low levels of tension and competition at high levels of tension may pose a problem. The change in tension levels may be the detrimental factor in activities which involve precise timing and coordination (Nideffer, 1970). Such results may imply the use of relaxation as an aid to performance in competition.

Subjects in a pre-relaxed condition showed greater velocity of movement of various loads than when the muscles were pre-tensed just before movement according to Berger (1969).

Tension and Pursuit Rotor Performance

Unskilled motor performance is characterized by excessive tension (Courts, 1942; Davis, 1939; Gregg, 1942; Russell, 1937. Courts (1942) found that the relationship between tension and early pursuit rotor practice and performance is the same as between tension and memorization.

Eason and White (1960) studied the relationship between fatigue induced by a suspended weight and performance during a pursuit rotor activity. Performance was found to be directly related to the length of the inter-trial interval (0, 10, 20, 40 seconds), and inversely related to the physical work load (0, 5, 10 pound weight suspended from the wrist). Muscle tension was found to be inversely related to the length of the performance interval, directly related to work and inversely related to performance. Other studies have also shown that pursuit rotor performance is facilitated by reduced muscle tension (Freeman, 1933; Eason and Branks, 1963). Pursuit rotor learning, however, was shown to be facilitated by tension (Freeman, 1938).

EFFECTS OF MOTOR ACTIVITY ON PHYSIOLOGICAL RESPONSE

Cardiovascular Response

> "The functional role of neural control of the vascular system is to adjust the cardiac output and the distribution of this total flow to meet the varying needs of tissues, maintain systemic arterial pressure and still preserve the essential functions of the heart, brain and other vital tissues." (Rushmer, 1976, p. 153)

The many adjustments to circulatory flow and pressure are effected by the sympathetic nervous system. The structure of vascular smooth muscle tissue is complex with, in some cases, the ability to react to both sympathetic and parasympathetic neural and transmitter input, and other cases to only specific responses such as changes in carbon dioxide tension (Rushmer, 1976).

Neural control of the peripheral vascular system is dominated by the sympathetic system. The diencephalon of the hypothalamus integrates reactions which involve the vascular system including temperature regulation, water balance, thirst, hunger and cardiovascular responses to exertion (Rushmer, 1976). The cardiac response to exercise can occur in anticipation of movement, anxiety or excitement as well as actual exertion (Schwartz, et al, 1971; Cohen, 1975; Little, 1977).

As reported in Little (1977), S.J. Sarnoff and associates performed a classic series of experiments in response to the finding that the heart size of an athlete tends to become smaller during exercise at a time when cardiac output is increased. The mechanism which allows the heart to balance the output of the right and left ventricles, "heterometric autoregulation", is achieved by altering the myocardial length. This relationship, known as the cardiac function curve, was found by Sarnoff to be affected by the degree of autonomic nervous system stimulation.

Blood Pressure

Rushmer (1976) defines "basal" blood pressure as "the arterial pressure present when all physical, emotional and metabolic activities are reduced to a physiologic minimum." (p. 193). A "basal" state being difficult to achieve, many investigators collect data on subjects who have rested quietly and comfortably for at least 30 minutes and 10 to 12 hours after the last meal. Fluctuations even under these conditions suggest the need for using average values of repeated measurements. The act of taking the blood pressure itself can cause an emotional reaction which may alter the reading. For a discussion of factors which affect systemic arterial pressure in addition to expressed or repressed emotions, see Rushmer, 1976, p. 193-194.

Bicycle and Treadmill Ergometers

Respiration and circulation need at least four minutes of work to adapt before a steady state can be achieved (Astrand, pamphlet). In his work with the bicycle ergometer, Astrand has proved the bicycle to be a very suitable work form. The use of large muscle groups allows the analysis of the oxygen transport function which is valuable in tests of physical fitness (Astrand, pamphlet).

Balke (1952) used 180 beats per minute as the breaking point for heart rate in a test of physical performance. Using the treadmill, heart rate, blood pressure and respiratory response were measured during gradually increased work. Prior experience on the treadmill was found to aid subjects.

MEDITATION AND TENSION REDUCTION

Tension reduction techniques have been reported to affect some areas of tension more then others. A cognitive technique such as passive meditation was reported by Blankstein (1973) to have a greater impact on a reduction of fear than on other measures, a somatic technique (slow, deep breathing) reduced respirations. The use of feedback reduced tension for wherever the feedback was given. A modified progressive relaxation technique reduced several of the measures studied, but not as significantly as other techniques reported (Blankstein, 1973.)

Combinations of techniques have been used as therapy by several investigators. Concluding a study of biofeedback and progressive relaxation, Braud (1978) suggested that in order to improve the technique, passive meditation needed to be included in the training.

Passive Meditation

Many forms of passive meditative techniques have been reported to reduce sympathetic arousal. Anand, et al (1971), in a study of highly experienced yoga meditators demonstrated a reduction in oxygen consumption, which suggested a reduction in metabolism and muscle tension. The reduction allowed the subject to remain in an air tight box for 11 hours while a control remained only six hours.

Elson, et al (1977) matched controls with Ananda Marga meditators for age, sex, height, weight, and as closely as possible in terms of customary and recent levels of physical activity. The subjects were measured in a meditation/eyes-closed relaxation state. The results may have been contaminated, reported Elson, due to the "extreme athletic fitness of the Dartmouth College volunteer controls". Findings were that no significant differences existed in the reduction in heart rate during meditation/relaxation. The controls initial rates were significantly lower than the meditators, 57.2 to 72.3 beats per minute respectively.

Deikman (1966), using a fixed gaze meditation concluded that the possibility exists that the "classical mystical experience....and other unusual experiences represent conditions of special receptivity to external stimuli ordinarily excluded or ignored in the normal state."

Progressive Muscle Relaxation

Weiner (1977) reported a reduction in state anxiety and frontalis EMG in Ananda Marga meditators and subjects using a progressive muscle relaxation technique. Results also showed the meditators did not significantly increase in self actualization over the progressive muscle relaxation group.

Transcendental Meditation and Wakefulness

Passive meditation techniques such as transcendental meditation have been reported to elicit the relaxation response (Benson, 1974). The EEG patterns in states of meditation indicate that conditions of trophotropic dominance are compatible with full awareness (Gellhorn, 1972), supporting the work of Wallace, Benson, and Wilson (1971) who report that transcendental meditation is a wakeful hypometabolic state.

A study of sleep during transcendental meditation led Pagano, et al (1976) to conclude that TM does not induce a "unique" state of consciousness such as the "wakeful hypometabolic state" suggested by Wallace and Benson (1972). Meditation, concludes Pagano, et al, is an activity that includes quite different states both from day to day and meditator to meditator.

Keeping subjects awake has been a problem in the comparison of relaxation techniques. Travis, et al (1976), in a study comparing transcendental meditators and controls showed only controls decreased in measures significantly over time. Many subjects in both groups slept during the 30 minute meditation-post meditation period. Younger (1975) supports the finding that transcendental meditators spend considerable portions of their time in Stage 1 sleep.

TM and Reduction in Physiological Functions

Meditation has been reported to have an effect on various physiological functions. Allison (1970) reported that during TM respiration becomes slow and shallow, with the rate being about half the resting rate. Respiratory changes at the beginning and end of meditation were immediate. Further, there was no evidence of compensatory over breathing at the end of meditation and no significant CO_2 buildup. Wallace (1970) and Wallace and Benson (1972) reported a decrease in heart rate during meditation. Decreases have also been noted in blood lactate, increases in electrical resistance of the skin and increases in slow alpha waves (Wallace and Benson, 1972).

Warrenburg, et al (1977) supported Benson's "relaxation response" hypothesis in a study of transcendental meditators and subjects using a progressive muscle relaxation technique. No difference was found between or within groups from treatment to eyes closed control periods.

Benson (1972, 1973) reported a significant reduction in blood pressure in hypertensive subjects after nine weeks of using the TM technique. The reduction was comparable to employing operant conditioning techniques according to Benson. Subjects who stopped meditating returned to control level blood pressure within four weeks. Blackwell, et al (1975) also found a reduction in blood pressure of moderate hypertensives with practice of the TM technique, and correlated this reduction with a decrease in anxiety as shown by the Spielberger State-Trait Anxiety Inventory. Wallace (1970) and Wallace and Benson (1972) report no substantial change in blood pressure during the meditation technique.

Cumulatory Effects of TM Practice

The concept of "unstressing" in TM is discussed by Goleman (1971). Involuntary and spontaneous movements sometimes occur when stress is being released. During the beginning of an individual's meditative practice these movements and other sometimes uncomfortable side effects may occur. Discomforting side effects can also occur with too frequent or too long a meditation period. As the meditator passes through this period of "normalizing" these responses rarely occur. The "normalizing" may take several months (Kanellakos, 1974).

Rogers (1977), reporting on cumulative effects of periodic relaxation, found after 10 weeks no significant changes occurred in 73 response measures taken on transcendental meditators.

The procedure of simply resting twice daily may account for some of the benefits claimed by the practicioners of TM according to Otis, et al (1974).

Vassiliadas (1973) of the Stanford Research Institute studied physiological changes of the TM practice over time. The changes that were observed in the study were slow to develop for the most part. Suggestion was made for the use of longer periods of time.

Experienced meditators have been reported to have more significant changes than their less experienced counter parts. This has been shown for trait anxiety (Davidson, et al, 1976; Ferguson and Gowan, 1976; Hjelle, 1974), self actualization (Ferguson and Gowan, 1976; Hjelle, 1974), decreased depression and neuroticism (Ferguson and Gowan, 1976), tonal memory (Frumkin, 1976), internal control (Hjelle, 1974), and phenylalanine concentration (Jevning, et al, 1976).

Plasma amino acid levels have been related to mental states. Jevning, et al (1976), in a study of transcendental meditators found that plasma phenylalanine levels significantly increased in long term meditators. Jevning hypothesized that the increase in phenylalanine resulted from a decrease in sympathetic activity which utilizes phenylalanine as a precursor to catecholamines. A prior study by Michaels, et al (1976), measuring plasma epinephrine, norepinephrine, and lactate, concluded that TM and "eyes closed" relaxation are biochemically equivalent. Michaels' finding using meditators with one or more years experience was not supported by Jevning (1976) whose study involved meditators with three to five years of experience.

TM and Disorders

Stutterers who were taught the TM technique reported an improvement in their speech. Subjects also indicated they felt better about themselves in general after six weeks of meditating (McIntyre, et al, 1974).

Wilson, et al (1975) reported the effects of TM practice on asthma. One group meditated, one group read. After three weeks scores in pulmonary function abnormalities (RAW) for the TM group worsened, but later improved beyond the control group. The groups were switched and the reading group was taught TM. The original TM group was asked not to meditate, but to read. At the end of three weeks the new TM group worsened, but later improved. An overall improvement in asthma condition was reported.

TM and Personality

Suggestion has been made that those persons who take up the practice of a meditation technique are different than the normal population. Fiebert (1977) found through an attitude survey those favoring personal growth will favor meditation. Otis (1974) reported about 50% of subjects in a study discontinued TM within 18 months. People who stay in TM, reports Otis, tend to have better integrated personalities than those who drop out. Williams, et al (1976) reported male prospective meditators were more introverted and more neurotic than normal, female prospective meditators had a higher psychoticism score. Over six months of practicing TM, subjects became less neurotic. The degree of reduction was related to the frequency of regular meditative practice.

<u>TM and Stress Reactivity</u>

Goleman and Schwartz (1976) studied stress reactivity of meditators with two or more years regular practice. An anticipatory increase in activation and a recovery phase decrease, indicating habituation of the anticipatory response, were both more pronounced for meditators than nonmeditators. TM was not seen as positive in terms of stress intervention if anticipatory arousal is used as an index of intervention.

The defensive anticipatory arousal becomes maladaptive, according to Goleman and Schwartz, when after the threat has passed, the arousal continues, failing to habituate. Meditation is then seen as "adaptive" in terms of recovery from stress arousal. In the Goleman and Schwartz study the stress recovery benefits of meditation were more pronounced in the experienced meditators and negligible in the less experienced suggesting effects are not quickly acquired and over time state effects could become traits. A passive defensive reaction was involved in the Goleman and Schwartz experiment who note the actual performance of meditators under stress as yet has not been studied.

MEDITATION AND PERFORMANCE

Habituation to Stress

Alpha blocking in meditators during meditation did not habituate under repeated acoustic stimulation in a study by Anand, et al (1961). Anand concluded this suggests a constant state of alertness during meditation.

In response to repeated presentations of noxious auditory stimuli (Orme-Johnson, 1973) meditators demonstrated fewer spontaneous GSRs, faster GSR habituation, and fewer multiple responses during habituation than nonmeditators. Nonmeditators planning to begin TM made higher resting levels of spontaneous GSR than nonmeditators in this study. Conclusions were drawn that the practice of TM contributes to the improvement of autonomic stability. Orme-Johnson (1973) reports that individuals exhibiting a high degree of autonomic stability tend to be less impulsive on motor tasks, have quicker perceptions, present behavior which is less conditionable to aversive stimuli, and habituate to tones faster. Rapid habituation is reported to be correlated with improved mental health (Orme-Johnson, 1973).

TM and Mental Health

Psychiatric patients were taught the TM technique as a treatment (Glueck, and Stroebel, 1975). Patients using TM had a higher recovery and discharge rate than age, sex, and MMPI matched controls. In the original study biofeedback and autogenic training groups were included. Due to the lack of persistency with the techniques, data could not be used regarding biofeedback and autogenic training in this study. TM was chosen for use in this study because it has been found that other types of passive mantra meditations, although producing similar findings, are not as consistent in results, and TM appears to produce a maximum effect more rapidly than any other technique (Gleuck and Stroebel, 1975).

Frew (1974) studied transcendental meditators who had full time jobs, concluding that job performance, job satisfaction, job stability and interpersonal relationships with co-workers and supervisors all seemed to improve in people participating in the TM program.

Martinetti (1976) reported that transcendental meditators showed greater response sensitivity to the Ames Trapezoid Illusion than controls who commented they were easily distracted from the task.

TM and Reaction Time

Appelle, et al (1974) studied reaction times of transcendental meditators. The meditators failed to show a learning curve in pre or posttest trials. A rest and task group demonstrated a learning curve in the pretrial only. Meditators, however, reduced within subject variance on the posttest and showed initial and final scores significantly better over rest and task groups. Results, according to Appelle, et al, suggest a correlation between reaction time and alertness.

TM and the Pursuit Rotor Task

Using a pursuit rotor tracking device, controls performed better than transcendental meditators during 10 second trials at 60 rpm (Williams and Herbert, 1976). A similar study showed no difference in terms of performance, learning, reminescence, and intra-individual ability between TM subjects and subjects who sat quietly with eyes closed prior to the pursuit rotor task (Williams and Vickerman, 1976).

SUMMARY OF THE REVIEW OF LITERATURE

The nature of physiological and psychological correlates of tension and meditation and the interrelationship of tension and performance have been reviewed. Tension and stress have been discussed as having effects on physiological variables and performance of tasks, inhibiting in some cases and facilitating in others. Motor activity produces stress as indicated by changes in physiological measures during activity. Sympathetic input, central to the reaction to stress, exhibits an idiosyncratic pattern, and is a component in the physiological changes associated with motor activity. Individual perception and appraisal is important as to whether a stress response is elicited. The maintenance of tension when not needed may interfere with performance and have a long term effect on health. Increased habituation to a stressor or the confrontation of stress in a more relaxed state may have a more positive effect on health as well as performance.

Meditation was viewed as potentially producing a profound state of relaxation. Differences in measures over time implicate a changing of state effects into traits. The need for an investigation of the effects of immediate prior use and long term regular practice of a simple form of passive meditation as an aid to the coping process during the performance of a motor activity has become apparent as a result of this review of precedent research.

CHAPTER III

METHODOLOGY

Sample Description

A group of meditators and a group of nonmeditators comprised the samples for this study. The meditation group was 16 transcendental meditators who had regularly practiced the TM technique for three or more years. Six of the meditators had received advanced training (Siddha) in the TM technique. Sixteen Oregon State University students who were matched as closely as possible with the meditation group for sex, age, height, weight, and current and customary activity level and who had no history of practice of a relaxation technique formed the nonmeditation group. Subjects were medically cleared as apparently healthy for participation in the study by a physician associated with Oregon State University. Clearance was based on the review of a Self Report Medical History Form (Appendix C) and a 12-lead resting ECG obtained by the experimenter. A resting ECG indicates cardiac function is adequate under resting circumstances. Subjects gave written consent to be used as subjects prior to the administration of the resting ECG.

Method of Obtaining Consent

During an advanced TM lecture in the Fall of 1978, the experimenter presented a brief description of the study to be undertaken and its requirements for the subjects. Further contact was made on a referral basis for additional meditation subjects. Written consent was obtained from those individuals agreeing to volunteer as subjects for the study by way of the Acknowledgement of Willingness to Participate form (Appendix A). A Questionnaire-Relaxation and Motor Activity Study (Appendix B-1), Self Report Medical History Form (Appendix C), and a personal interview were also given to determine the qualifications and vital information for each subject.

Nonmeditation subjects were sought through the use of posted notices, announcements in classes, and the university student newspaper. Acknowledgement of Willingness to Participate forms, questionnaires (Appendix B-2), Self Report Medical History forms, and personal interviews were given nonmeditators who volunteered for the study. Data from the completed forms was used to select subjects who were acceptably paired with each meditation subject.

Anonymity of all subjects was maintained by assigning a number to each subject which was recorded on the questionnaire and Self Report Medical History Form. Thereafter only assigned numbers were used to identify subjects.

Sample Pairing

Subjects were matched as closely as possibel within variances on selected variables. Variances allowed for each of the matching variables were: sex, none; age, ± one year; height, ± one inch; weight, ± five pounds; current and customary activity level, subjective evaluation based on the responses of each prospective participant to the Questionnaire-Relaxation and Motor Activity Study (Appendix B-1, B-2). Means and standard deviations of the meditation and nonmeditation groups are presented in Tables 1a and 1b. Subjects ranged in ages from 18 to 32 years. Sixteen males and 16 females participated in the study.

Experimental Design

A pretest-posttest control group randomized blocks design was used in this study (Campbell and Stanley, 1963). The following steps were taken to match subjects and establish groups. Sixteen transcendental meditators with three or more years experience in the

TABLE 1 a

MEANS AND STANDARD DEVIATIONS OF MATCHING CRITERIA VARIABLES FOR THE MEDITATION GROUP

	Age in Years	Height in Inches	Weight in Pounds	Fitness Level*	Years Experience Meditating
Experimental					
Mean	26.4	68.8	141.9	2.5	4.7
Standard Deviation	2.7	3.5	12.2	0.8	1.3
Control					
Mean	26.3	67.9	137.5	2.4	5.3
Standard Deviation	4.5	4.0	24.9	0.7	2.2
Total					
Mean	26.3	68.3	139.7	2.4	4.9
Standard Deviation	3.6	3.7	19.1	0.7	1.8

*Fitness level: Good, 3; Fair, 2; Poor, 1.

TABLE 1 b

MEANS AND STANDARD DEVIATIONS OF MATCHING CRITERIA VARIABLES FOR THE NONMEDITATION GROUP

	Age in Years	Height in Inches	Weight in Pounds	Fitness Level*
Experimental Mean	25.9	69.0	143.1	2.5
Standard Deviation	2.6	3.7	16.0	0.8
Control Mean	26.1	67.9	137.5	2.4
Standard Deviation	4.8	4.1	25.2	0.7
Total Mean	26.0	68.4	140.3	2.4
Standard Deviation	3.7	3.8	20.6	0.7

*Fitness level: Good, 3; Fair, 2; Poor, 1.

TM technique were recruited to form a meditation group (M). A population of 35 nonmeditation subjects (NM) having no history of relaxation training were recruited out of which 16 were chosen who were each matched as closely as possible with a paired subject in the meditation group for sex, age, height, weight, and current and customary activity level.

Matched pairs of meditators and nonmeditators were assigned to two subgroups. An attempt was made to evely distribute meditation subjects by sex, length of meditation experience, advanced training in meditation and range and mean age. Each subgroup of eight subjects contained four males and four females. Three meditators in each subgroup had received advanced training in meditation (Siddha). (See Tables 1a and 1b).

Matched subgroups were then randomly selected for experimental (E) or control (C) procedures. Experimental groups performed a pretest and posttest of a pursuit rotor task and a bicycle task. Immediately prior to performance of the posttest experimental groups received a treatment period.

Treatment consisted of a meditation period of 15 or 20 minutes for the meditation group based on personal customary practice. Treatment for the nonmeditation group consisted of relaxing with eyes closed for a corresponding length of time to their matched meditator. Control groups performed the pretest and posttest procedures without the treatment period. Pretest and posttest procedures were identical for all groups.

Figures 1 and 2 illustrate the design and comparisons made within the design.

Criterion Instruments

The criterion instruments used in this study were the electrocardiograph, electromyograph with time period integrator, sphygmomanometer, pursuit rotor tracking device with time on target chronograph, and bicycle ergometer. The pursuit rotor tracking device was chosen as an instrument for providing a fine motor task. The use of the pursuit rotor for this purpose has been established in the literature (Eason, 1963; Eason and Branks, 1963; Eason and White, 1960).

The bicycle ergometer was chosen as a measure of gross motor cardiovascular stress. The use of the bicycle ergometer for this purpose is supported by Astrand (pamphlet). In addition, the bicycle ergometer may be adjusted for work load, and a reliable instrument for establishing a progression of work load was available (Luft Progressive Bicycle

	Pretest		Posttest
MEDITATION GROUP			
Experimental Subgroup (EM)	Observation	Treatment	Observation
Randomized			
Control Subgroup (CM)	Observation		Observation
NONMEDITATION GROUP			
Experimental Subgroup (ENM)	Observation	Treatment	Observation
Randomized			
Control Subgroup (CNM)	Observation		Observation

Figure 1

Illustration of the Pretest-Posttest Control Group Randomized Blocks Design used in this study.

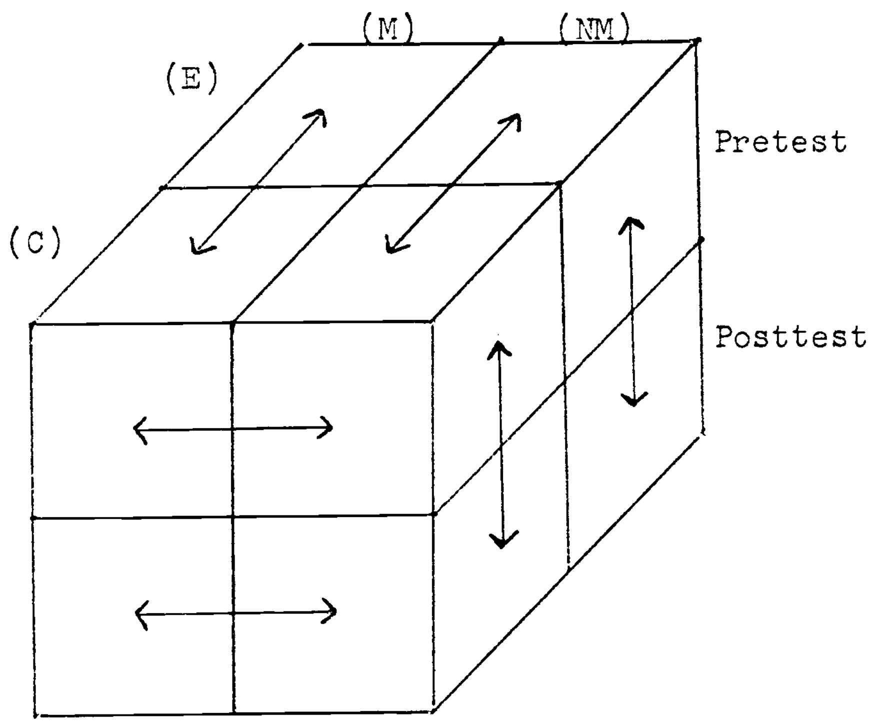

Figure 2

Comparisons made in the Pretest-Posttest Control Group Randomized Blocks Design used in this study.

Ergometer Performance Test, Luft, 1963, Appendix F).

Muscle strains are an inherent risk in most vigorous physical activities. A progressive increase in work load beginning with little resistance and gradually increasing resistance minimizes the chance of muscle strain. The Luft protocol increases work load more often and with smaller increments than does the Balke (pamphlet) or Astrand (pamphlet) bicycle ergometer protocols, and was chosen for this reason.

A severe work load will cause the heart to be stressed. Monitoring the heart rate on an ECG allowed the experimenter to note apparent malfunctions in the heart and be able to reduce the load before a crisis would occur. The review of a 12-lead resting ECG prior to activity does not allow a physician to certify the subject will not have a cardiac emergency, but does enable the physician and experimenter to make some assumption as to apparent health. Stressing the subject to 70% age predicted maximum heart rate, rather than 85% or 90%, allowed the experimenter to assure moderate cardiovascular stress while minimizing the risks involved. Each subject was asked to adhere to certain requests (Appendix D) prior to coming to the laboratory. The requests were designed to guard against effects of variables which could confound the results as well as to minimize the risks to the subject.

The task would have been stopped if any of the following had occurred: irregularities in ECG such as depressed S-T segment appeared, ECG reflected three preventricular contractions in a row, blood pressure decreased during activity, systolic blood pressure reached 180 mmHg, subject felt nauseated, dizzy, subject experienced muscle cramps, anginal pain, or upon the subject's request. The task was stopped when the subject reached 70% age predicted maximum heart rate (Appendix E).

Criterion Measures

The physiological criterion measures for this study were heart rate, and systolic blood pressure as measures of cardiovascular adjustment (Astrand, pamphlet; Balke, 1952), and one-minute integrated average frontalis EMG values as a measure of the "spread" of muscle tension (Freeman, 19?1, 1933). Rate-pressure product (RPP) was also computed for the bicycle task as a measure of internal work.

Criterion performance scores for the pursuit rotor task were the time-on-target values for each of the five trials. As well as being a measure of fine motor skill, involving eye-hand coordination, the time-on-target score allows a relative index of effort (Eason, 1963). The length of time of performance on the bicycle ergometer before the target heart rate was reached served as the performance score for the gross motor activity of the bicycle task (Luft, 1963).

Comparisons were based on actual scores between groups except for the performance time period of the bicycle where interpolated data was used for the physiological measures.

Screening Session

During the first session meditators and matched nonmeditators were given a resting 12-lead ECG. The first session also included a brief orientation to the laboratory and equipment to be used. Pending medical clearance, the subject was asked to refrain from certain activities on the day of their participation in the next session in order to reduce the effect of variables which might alter performance such as rest or exercise periods and consumption of food or drugs. An explanation of these cautions was given the subject during the first session (Appendix D, Instructions to Participants, Relaxation and Motor Activity Study). Subjects were also informed that arrangements had been made for the use of the shower facilities at Dixon Recreation Center near the laboratory following each session (Appendix G, Shower Pass).

The Self Report Medical History Form and resting 12-lead ECG were reviewed by a physician. Subjects were notified of the results and a schedule of appointments made if medically cleared for participation. An attempt was made to schedule the two test times at the same hour one week apart. The subjects with whom they were matched were scheduled as closely as possible to the same hour, but may have been a different day of the week or a different week.

Pretest-Posttest Sessions

Subjects in both meditation and nonmeditation groups, in two separate sessions, performed five one-minute trials with a 30 second interval between trials of a pursuit rotor tracking task. Subjects also performed the Luft bicycle ergometer protocol to 70% age predicted maximum heart rate. During each of these tasks subjects were monitored for heart rate, blood pressure and frontalis EMG. Experimental subjects received a treatment period of meditation (meditators) or eyes closed relaxation (nonmeditators) immediately prior to the posttest.

Upon entering the laboratory the subject was questioned regarding adherence to the instructions they were to follow (Appendix D). Three electrodes were placed on the frontalis muscle for monitoring EMG. Figure 3 shows placement of electrodes and headphones for securing lead wires. A Cyborg Electromyograph J33 and a Sp2 WN41-2 RMS Dual Processor and Time Period Integrator were used to collect data on frontalis muscle EMG activity and a chronograph for securing time on target performance scores for the pursuit rotor task. Instruments are pictured in Figure 4.

A standard CM5 lead II was used for ECG monitoring. Figure 5 shows placement of leads. A Birtcher Model 344 Electrocardiograph was used to collect data on heart function and is pictured in Figure 6. Electrodes and connecting wires were held in place and out of the subject's way with six inch elastic bandages secured around the torso. A set of headphones were attached to the head to secure the frontalis EMG wires. Figure 7 shows the rear view of EMG and ECG lead wires.

A blood pressure cuff was snugly placed on the non-dominant arm of the subject. Figure 8 shows

Figure 3

Bipolar placement of electrodes for frontalis EMG monitoring. The net difference in action potentials were monitored between the two active electrodes. The middle electrode is a ground. One minute integrated averages of root mean square were used for computation of frontalis EMG activity. Headphones were placed over the head to secure the lead wires.

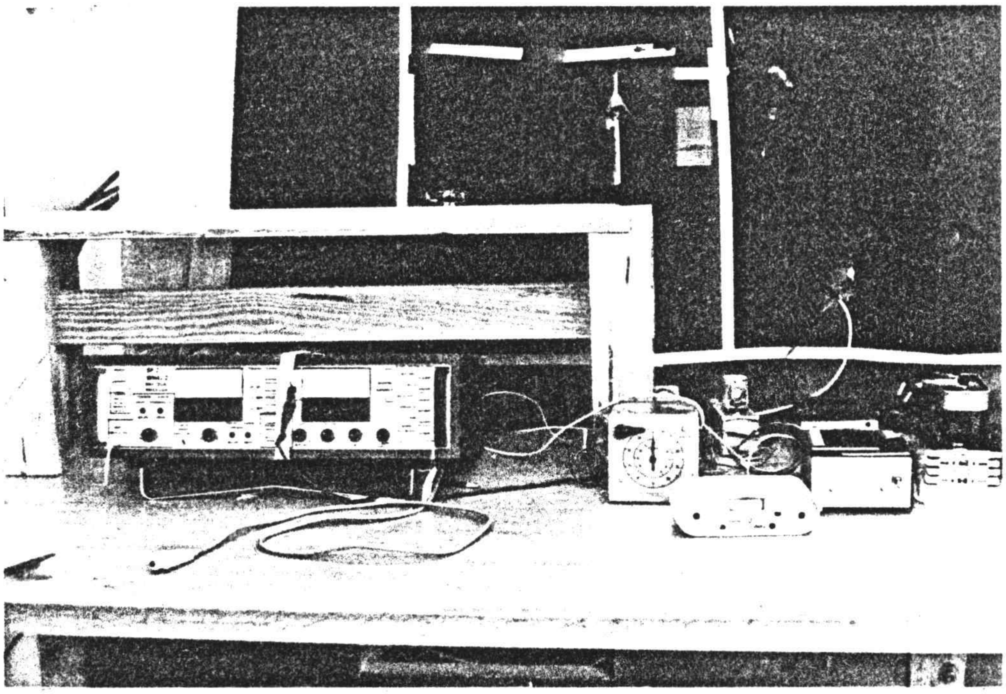

Figure 4

Cyborg Electromyograph J33 and SP2 Wn41-2 Dual Processor and Time Period Integrator, and time on target chronograph.

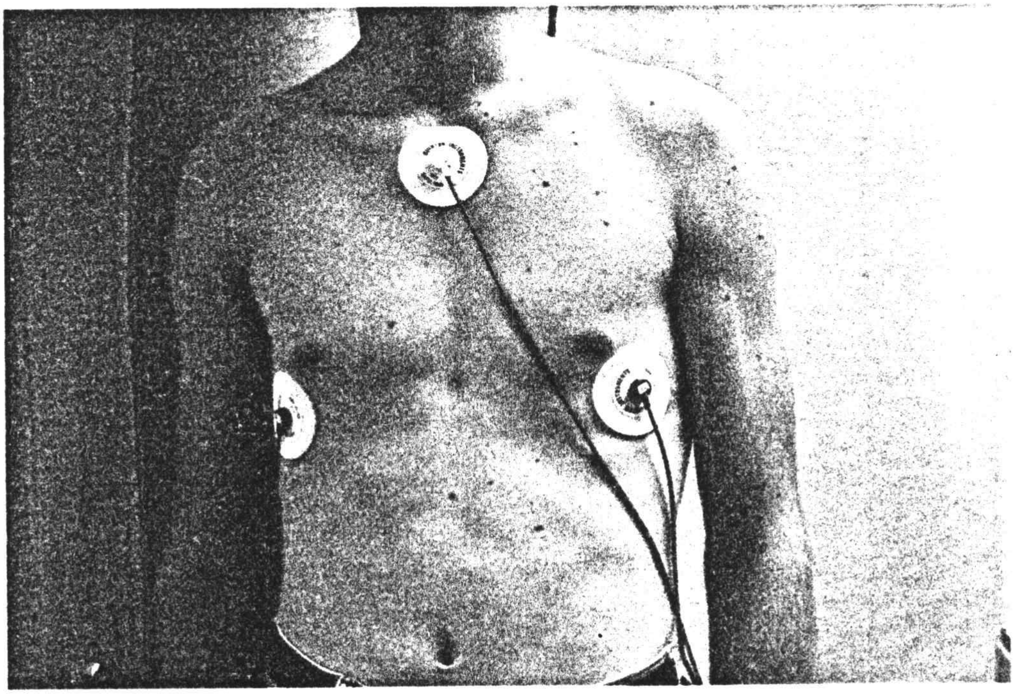

Figure 5

Standard CM5 lead II placement of ECG electrodes. Electrodes placed at the top of the sternum and at the V5 position on the left thorax are active in this bipolar system. The electrode on the right thorax is a ground.

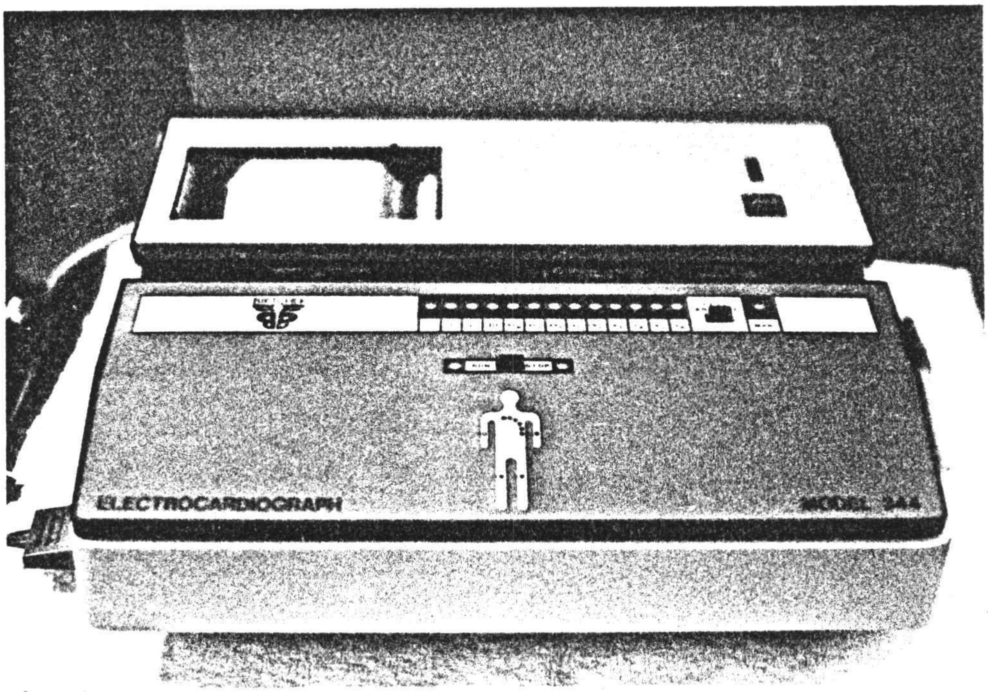

Figure 6

Birtcher Model 344 Electrocardiograph

Figure 7

Rear view of EMG and ECG lead wires. Note three EMG lead wires secured by headphones hanging down the back of the head and clipped together at the belt with the three ECG lead wires brought around to the back. The thick black cord is a part of the headphone set and served no purpose in this study.

Figure 8

Attachment of blood pressure cuff and bandage securing the EMG and ECG lead wires to subject.

attachment of blood pressure cuff and bandage securing the EMG and ECG lead wires to subject. After the proper position was ascertained by a trial blood pressure reading, the stethoscope bell was taped to the subject's arm.

The subject was asked how their day went, how they felt, with particular attention paid to any extra stresses that may be influencing their lives at that particular time. The information was noted and retained with the subject's data forms.

A schedule of data collection is shown in Tables 2a and 2b.

Pursuit Rotor Task

A five minute sitting adaptation period preceded the pursuit rotor task (Burns, 1971). Baseline readings for heart rate, blood pressure and one-minute integrated average EMG values were taken during minutes 3, 4, and 5 of the adaptation period (Burns, 1971; Goldstein, 1977; Kinsman, 1978; Rushmer, 1976).

The subject was then informed as to the nature of the pursuit rotor task. Instructions were given on cassette tape to assure standardization. The pursuit rotor device was activated so that the moving light

TABLE 2a

DATA COLLECTION SCHEDULE

Pursuit Rotor Task		
Adaptation Period[a]	Heart Rate[b]	- sixth 10-second period of minutes 3, 4, and 5
	Blood Pressure[c]	- following minute 5
	Frontalis EMG[d]	- during minutes 3, 4 and 5
Performance Period[e]	Heart Rate	- anticipation of each trial, 10 seconds prior to start
	Blood Pressure	- during the interval between trials
	Frontalis EMG	- during each trial
Recovery Period[f]	Heart Rate	- sixth 10-second period of each minute
	Blood Pressure	- at the end of the recovery period
	Frontalis EMG	- during each minute

[a] five minutes in length
[b] measured in beats per minute
[c] measured in mm Hg
[d] one-minute integrated averages measured in microvolts
[e] five one minute trials with 30 seconds between trials
[f] five minutes in length

TABLE 2b

DATA COLLECTION SCHEDULE

Bicycle Task		
Adaptation Period[a]	Heart Rate[b]	- sixth 10-second period of minutes 3, 4, and 5
	Blood Pressure[c]	- following minute 5
	Frontalis EMG[d]	- during minutes 3, 4, and 5
Performance Period[e]	Heart Rate	- anticipation of performance, 10 seconds prior to start - sixth 10-second period of each minute
	Blood Pressure	- following heart rate reading, at the beginning of each minute
	Frontalis EMG	- during each minute
Recovery Period[f]	Heart Rate	- sixth 10-second period of each minute
	Blood Pressure	- following heart rate reading, at the beginning of each minute
	Frontalis EMG	- during each minute

[a] five minutes in length
[b] measured in beats per minute
[c] measured in mm Hg
[d] one-minute integrated averages measured in microvolts
[e] the length of time of performance until the subject reaches the target heart rate of 70% age predicted maximum (Appendix E)
[f] ten minutes in length

followed the track in a clockwise direction and the speed set at 60 revolutions per minute. The Layfayette Phytoelectric Pursuit Rotor device used in this study is pictured in Figure 9. The task was performed in five one-minute trials. Figure 10 depicts the subject performing the pursuit rotor task.

Following instructions for the pursuit rotor a 10 second warning was given in which heart rate was taken. Heart rate was taken during the second, fourth and sixth 10 second periods of each one-minute trial and during the 10 second warning period prior to each trial (Folkins, 1970). Frontalis EMG was recorded as an integrated one-minute average during each trial (Epstein and Webster, 1975). A 30 second interval between trials allowed the experimenter to take the subject's blood pressure. Following the fifth trial the subject sat in a nearby chair for a five minute recovery period (Folkins, 1970; Jones, 1946) during which the heart rate and frontalis EMG readings were taken as during the trial periods. Blood pressure was taken at the end of the recovery period.

Bicycle Task

The pursuit rotor task was followed by performance

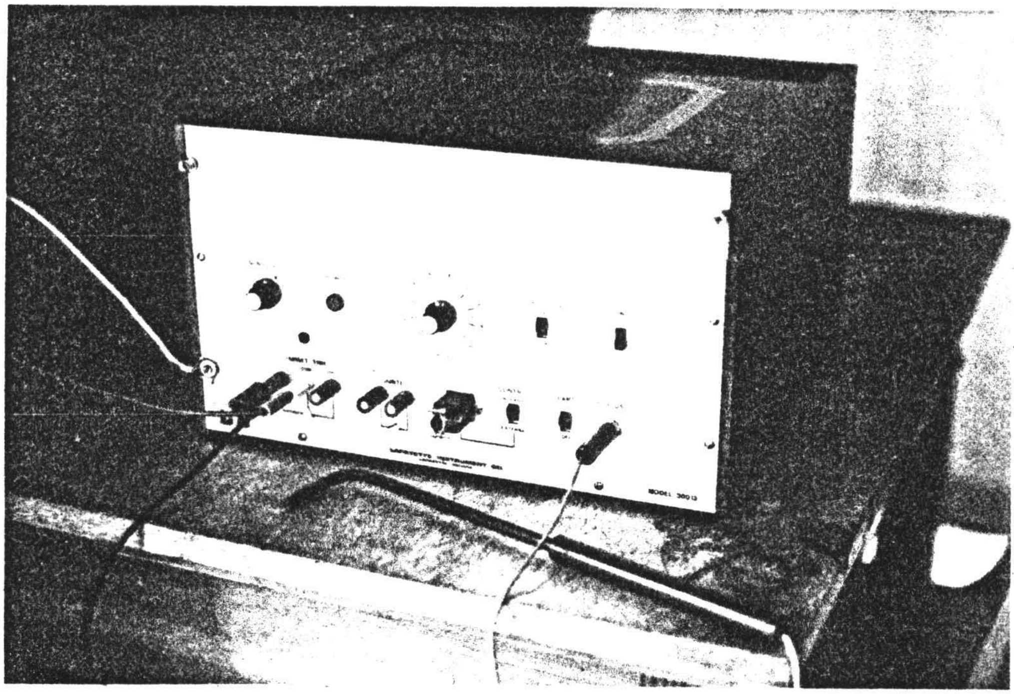

Figure 9

Layfayette Photoelectric Pursuit Rotor device. Direction of the moving light was set to follow a clockwise direction at 60 rpm. The metal rod which subjects used to track the moving light is shown lying on the table.

Figure 10

Subject depicted performing the pursuit rotor task. Note attachment of lead wires and blood pressure cuff allowed the subject freedom of movement for the task. The electrocardiograph and electromyograph were out of the subject's view and the sphygmomanometer was placed such that the subject could not see the measurement.

of the Luft Progressive Bicycle Ergometer Performance Test (Appendix F) to a pre-established target heart rate of 70% age predicted maximum (Appendix E) while being monitored for heart rate, blood pressure and frontalis EMG. The length of time in minutes taken to reach the pre-established target heart rate was also recorded.

The subject first sat in a chair for five minutes (adaptation period) which allowed baseline readings for the bicycle task to be taken during minutes 3, 4, and 5. Following the adaptation period the subject hyperventilated for 30 seconds. The electrocardiograph was monitored during hyperventilation and for 15 seconds following. While no subject exhibited arrythmias or irregular cardiac function during hyperventilation or the period following, if such had occurred there would have been a delay in testing.

Once recovered, the subject mounted the bicycle. Figure 11 shows the Monarch Bicycle Ergometer used in this study. The seat was adjusted for comfort and proper leg extension. Location of the adjustment was noted for the posttest. Instructions were given to the subject while they were sitting on the bicycle. Instructions were given on cassette tape to assure standardization. The subject was asked to pedal at

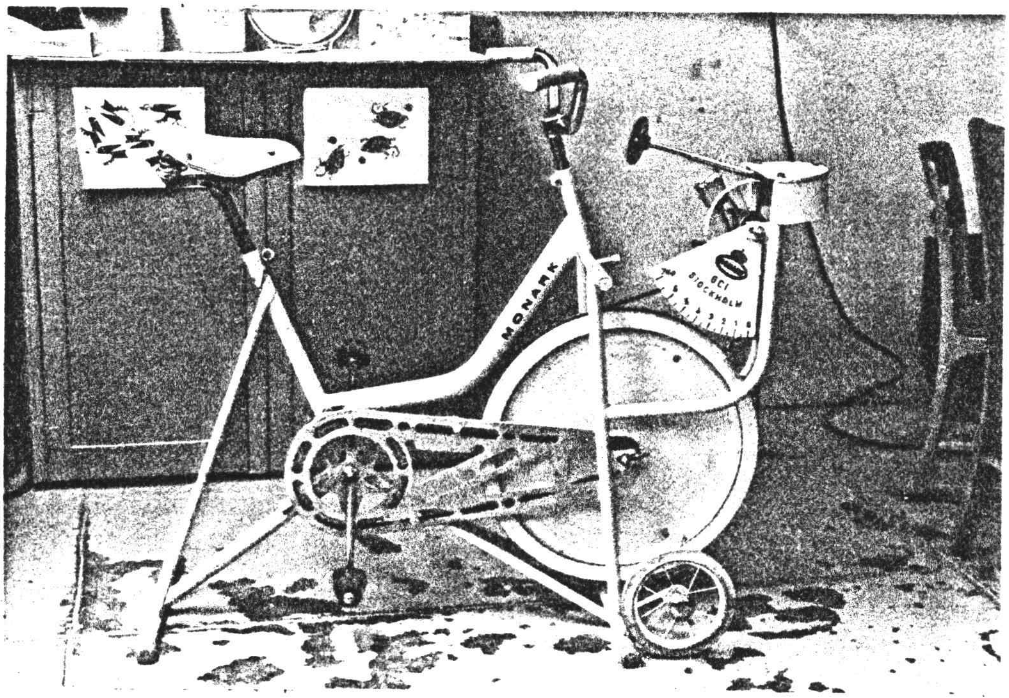

Figure 11

Monarch Bicycle Ergometer. Seat position was adjusted to provide comfort and proper leg extension for the subject. Resistance to pedalling was increased by $\frac{1}{4}$ kilopound each minute as per the Luft protocol (Appendix F). A tachometer on the bicycle and a metronome placed visually in front aided the subject in keeping a set pedalling speed of 50 counts per minute which is approximately 22 kilometers per hour.

50 counts per minute during the task as indicated by the flashing light on a metronome placed visually before them. The speed was approximately 22 kilometers per hour which was also indicated by the tachometer. Extra movements such as turning to see what the experimenter was doing or to look at the instruments other than the metronome would affect the readings and the subject was asked for this reason to attend to the task until told to do something different. Figure 1.12 depicts the subject performing the bicycle task. The subject was reminded that if severe discomfort, pain in the chest, nausea, dizziness, or other unusual symptoms were experienced, he or she was to notify the experimenter immediately and the task would be terminated. During the pretest, a nonmeditation subject was excused and replaced with a comparable matching subject.

Upon completion of the task the subject was asked to continue pedaling for an additional minute at the same cadence, but at 0 Kp load. The subject was then moved to a nearby chair for the remainder of the recovery period.

A 10 second warning was given prior to the beginning of the Luft protocol (Folkins, 1970). The heart rate was taken during this warning and during the sixth 10 second period of each minute of the task.

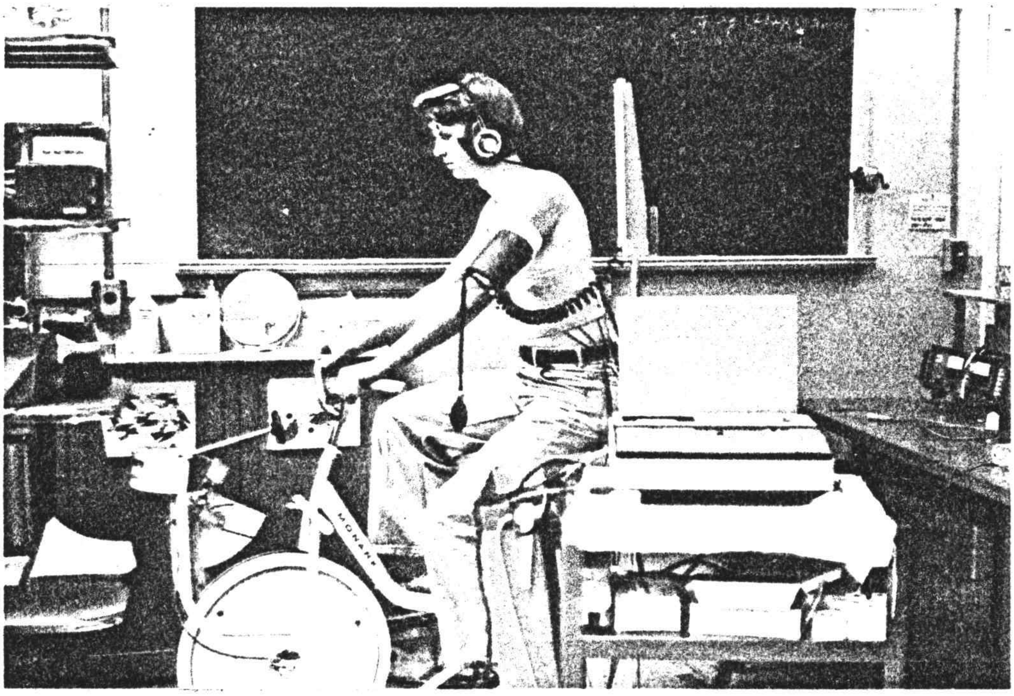

Figure 12

Subject depicted performing the bicycle task. The metronome is a small black box on a shelf at the far left. Note attachment of lead wires and blood pressure cuff allowed the subject freedom of movement for the task. A cardboard screen blocked the subject's view of the electrocardiograph. The sphygmomanometer was placed behind the subject, and the subject was positioned so that the electromyograph was out of view.

Blood pressure was taken immediately following each heart rate reading. EMG values were taken as repeated one-minute integrated averages during each minute of the task. Measurements continued to be taken each minute of the 10 minute recovery period (Jones, 1946; Folkins, 1970).

Meditation/Relaxation Period

The experimental subjects were given a treatment (meditation/relaxation period) immediately prior to performance of the posttest. The experimental meditation subjects meditated for 15 or 20 minutes, depending on customary practice, followed by 10 minutes of sitting quietly with eyes closed. Experimental nonmeditation subjects sat and relaxed with eyes closed for a corresponding length of time to the meditation subject with whom they were matched.

Subjects were seated in a comfortable chair in a darkened room. The headphones used to hold the frontalis EMG wires in place assisted in blocking out extraneous sounds during the meditation/relaxation period. Instructions were given as to the procedure for the meditation/relaxation period and post meditation/relaxation period on a cassette tape to assure standardization. Subjects were asked to sit for five minutes with their eyes open (adaptation period), during which baseline readings were taken for heart rate and frontalis EMG during minutes 3, 4, and 5. Blood pressure was taken following minute 5 (Burns, 1971; Kinsman, 1978). The subjects were instructed to begin the meditation/relaxation period. Heart rate was taken during the last 10 second period of each minute of meditation/relaxation. Frontalis EMG values were one-minute integrated averages during each minute of meditation/relaxation (Epstein and Webster, 1975). After 20 minutes, the experimenter entered the room and asked the subject to continue sitting with eyes closed for 10 more minutes. Blood pressure was taken at this time. During the 10 minute post-meditation/relaxation period, heart rate and frontalis EMG values continued to be taken. Following the post-meditation/relaxation period, subjects were asked to slowly open their eyes and blood pressure was again taken.

A short questionnaire was given to the subjects following the post-meditation/relaxation period (Appendix H, Post Meditation/Relaxation Questionnaire). Subjects were asked to indicate how well they were able to meditate/relax on a scale of 1 - 5, if they think they went to sleep, when, and about how long they slept.

The third session was concluded for experimental subjects with performance of the posttest of the pursuit rotor task and bicycle task. Control subjects performed the posttest without the prior meditation/relaxation period. Measurements for the posttest were taken as per the pretest. See Tables 2a and 2b, Data Collection Schedule, page 72-73. Data collection forms for the pursuit rotor task and bicycle task, and the meditation/relaxation period are presented in Appendix I, J, and K.

CHAPTER IV

RESULTS AND DISCUSSION

The data obtained from the 32 subjects on pretest and posttest of the pursuit rotor task and bicycle task were compiled into appropriate categories and are presented in this chapter. The data are discussed under three broad headings relating to the appropriate hypotheses: (1) Pattern of Physiological Response, (2) Level of Performance, and (3) Relationship of Performance to Physiological Response. Under each broad heading the pursuit rotor task data is presented first followed by the bicycle task data.

A pretest-posttest randomized blocks design was used with groups compared on three levels: (1) Meditators and Nonmeditators, (2) Experimental and Control Groups, and (3) Pretest and Posttest. Comparisons are made within each of these categories on each of the physiological variables. Variables include heart rate, blood pressure, frontalis EMG, and for the bicycle task, rate-pressure product (RPP).

An analysis of variance of the trends of the trial means (Grant, 1956) was used to test the first hypothesis relating to the pattern of physiological response. A level of significance of .05 was selected for acceptance or rejection of the null hypothesis. Tables and graphs are presented to illustrate and clarify where significant difference occurred. Mean values for the physiological variables during each time period as computed for each group are also presented.

Hypothesis two, which relates to the difference in levels of performance between comparative groups, was tested with an analysis of variance of the trends of the trial means and an analysis of variance of means for the pursuit rotor task, and an analysis of variance of means for the bicycle task. A significance level of .05 was selected for acceptance or rejection of the null hypothesis. Tables and graphs are presented to illustrate and clarify where significant difference occurred. Mean time on target scores are presented for each trial of the pursuit rotor task. Mean bicycle task performance scores are also tabled and presented.

A multiple regression analysis was used to test the third hypothesis which establishes the relationship of performance (dependent variable) to physiological response (independent variable). Tables are presented to show significant regression coefficients of multiple correlations.

Since the coefficients of multiple regression

(R) may be a result of chance or sampling error, an analysis of variance of significance of R was also computed. A significant F-ratio indicated that a significant linear relationship existed between the dependent and independent variables identified. A .05 level of significance was selected as showing a significant linear relationship. If R proved significant, a further correlation of .85 was necessary for acceptance or rejection of the null hypothesis.

Pattern of Physiological Response

Pursuit Rotor Task

The pursuit rotor tracking device was designated as an instrument to measure fine motor task involving eye-hand coordination and localized movement. Selected time periods were analyzed for the pursuit rotor on the assumption the pattern of physiological response might occur in certain time periods and not in others. Time periods selected for the pursuit rotor task data analysis were: adaptation value and anticipation value of each trial (six values), the second 10 second period of each trial (five values), the fourth 10 second period of each trial (five values), the sixth 10 second period of each trial (five values), the sixth

10 second period of the fifth trial through recovery (six values). Heart rate, blood pressure, and frontalis EMG response will be discussed as they relate to the comparison of groups in selected time periods.

Heart Rate. Tables 3a through 3e provide mean heart rate values for each group during each time period. Table 4 provides F-ratios and descriptions of significant trend difference found in heart rate response between meditators and nonmeditators. Figures 13a through 13c illustrate difference in trends presented in Table 4. Analysis of variance tables are provided for each significant trend difference (Table 5a through 5c).

Comparing meditators and nonmeditators in the experimental condition, a quartic trend difference was found during the sixth 10 second period of the posttest. No significant difference was found in any time period of the pretest between these groups. Control meditators and nonmeditators showed a quadratic difference in trends during the adaptation/anticipation time period of the pretest and a quartic trend difference during the sixth 10 second heart rate of the last trial through recovery of the pretest. No significant difference was found for the control condition comparing meditators and nonmeditators during the posttest.

TABLE 3a

MEAN HEART RATE RESPONSE* TO THE PURSUIT ROTOR TASK
DURING ADAPTATION AND ANTICIPATION OF EACH TRIAL

Groups	Adaptation	Anticipation of Each Trial				
		1	2	3	4	5
Meditators						
Experimental						
Pretest	69	93	84	84	87	91
Posttest	66	83	82	78	79	83
Control						
Pretest	64	81	76	79	76	81
Posttest	85	83	77	77	83	83
Nonmeditators						
Experimental						
Pretest	79	98	95	93	99	97
Posttest	69	87	80	84	80	87
Control						
Pretest	74	93	93	90	87	90
Posttest	72	86	81	89	88	85

*indicated in beats per minute

TABLE 3b

MEAN HEART RATE RESPONSE* TO THE PURSUIT ROTOR TASK DURING THE SECOND 10-SECOND PERIOD OF EACH TRIAL

	Trial				
Groups	1	2	3	4	5
Meditators					
Experimental					
Pretest	101	89	90	86	88
Posttest	85	80	81	82	82
Control					
Pretest	87	78	79	82.	79
Posttest	85	81	80	81	79
Nonmeditators					
Experimental					
Pretest	102	96	97	99	99
Posttest	83	82	84	85	85
Control					
Pretest	100	88	87	90	90
Posttest	88	83	84	84	83

*indicated in beats per minute

TABLE 3c

MEAN HEART RATE RESPONSE* TO THE PURSUIT ROTOR TASK
DURING THE FOURTH 10-SECOND PERIOD OF EACH TRIAL

Groups	Trial 1	2	3	4	5
Meditators					
Experimental					
Pretest	96	88	90	87	88
Posttest	83	82	81	84	84
Control					
Pretest	88	80	82	82	84
Posttest	87	81	83	84	85
Nonmeditators					
Experimental					
Pretest	100	99	99	101	103
Posttest	86	85	85	87	86
Control					
Pretest	102	92	91	92	92
Posttest	90	84	87	88	88

*indicated in beats per minute

TABLE 3d

MEAN HEART RATE RESPONSE* TO THE PURSUIT ROTOR TASK DURING THE SIXTH 10-SECOND PERIOD OF EACH TRIAL

Groups	Trial 1	2	3	4	5
Meditators					
Experimental					
Pretest	92	91	90	91	90
Posttest	84	84	86	82	85
Control					
Pretest	83	80	83	81	84
Posttest	86	85	79	83	86
Nonmeditators					
Experimental					
Pretest	100	99	98	101	101
Posttest	85	86	85	88	90
Control					
Pretest	97	93	93	94	94
Posttest	88	87	87	90	88

*indicated in beats per minute

Table 3e

MEAN HEART RATE RESPONSE* TO THE PURSUIT ROTOR TASK
DURING THE FINAL PERFORMANCE HEART RATE THROUGH RECOVERY

Groups	Final Performance Heart Rate	Recovery 1	2	3	4	5
Meditators						
Experimental						
Pretest	90	72	67	70	68	67
Posttest	85	70	65	68	67	66
Control						
Pretest	84	61	62	62	63	65
Posttest	86	64	65	67	64	66
Nonmeditators						
Experimental						
Pretest	101	77	78	76	78	78
Posttest	90	69	66	68	72	71
Control						
Pretest	94	70	68	68	71	67
Posttest	88	69	70	68	70	72

*indicated in beats per minute

TABLE 4

SIGNIFICANT* COMPARISONS OF TREND OF HEART RATE RESPONSE TO THE PURSUIT ROTOR TASK BETWEEN MEDITATORS AND NONMEDITATORS

	Adaptation/ Anticipation of Each Trial	Second 10-second Period of Each Trial	Fourth 10-second Period of Each Trial	Sixth 10-second Period of Each Trial	Final Performance Heart Rate/ Recovery
Experimental					
Pretest					
Posttest				quartic F 9.93	
Control					
Pretest	quadratic F 5.05				quartic F 5.18
Posttest					

*F of 4.60 needed for significance at .05 for df 1,14

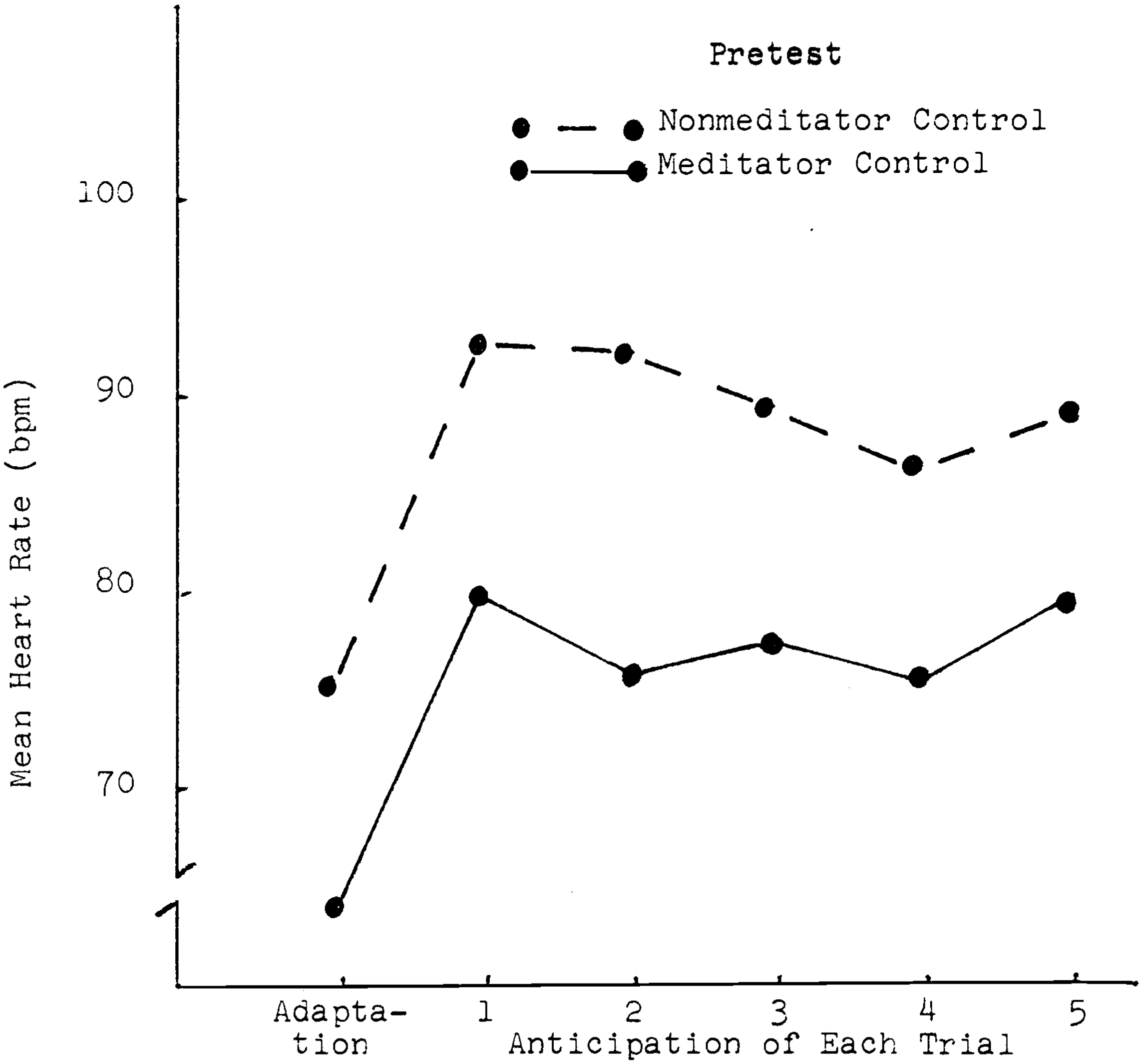

Figure 13a

Pursuit Rotor Heart Rate Response Comparing Meditator and Nonmeditator Control Groups During Adaptation and the Anticipation of Each Trial of the Pretest.

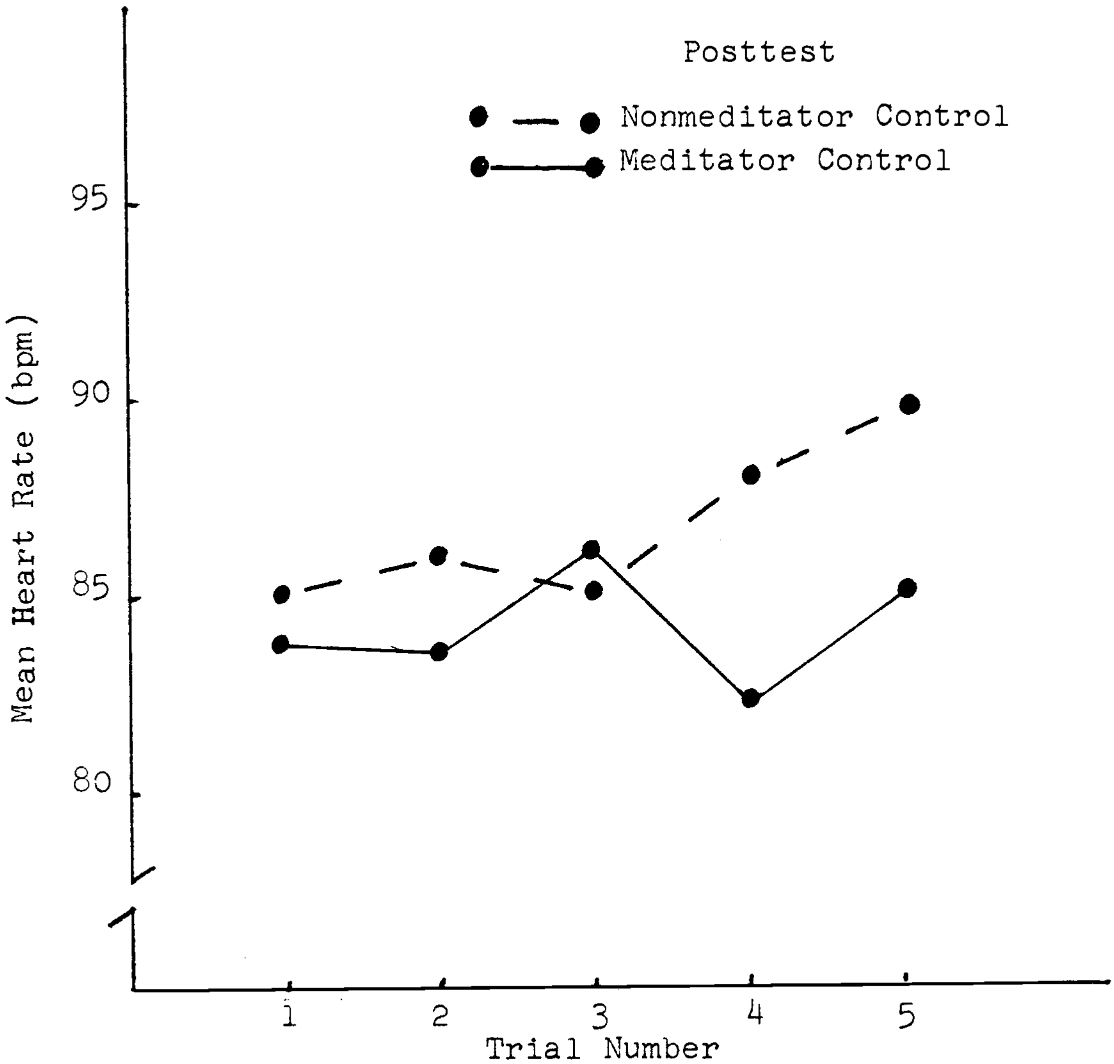

Figure 13b

Pursuit Rotor Heart Rate Response Comparing Meditator and Nonmeditator Control Groups During the Sixth 10-Second Period of Each Trial of the Posttest.

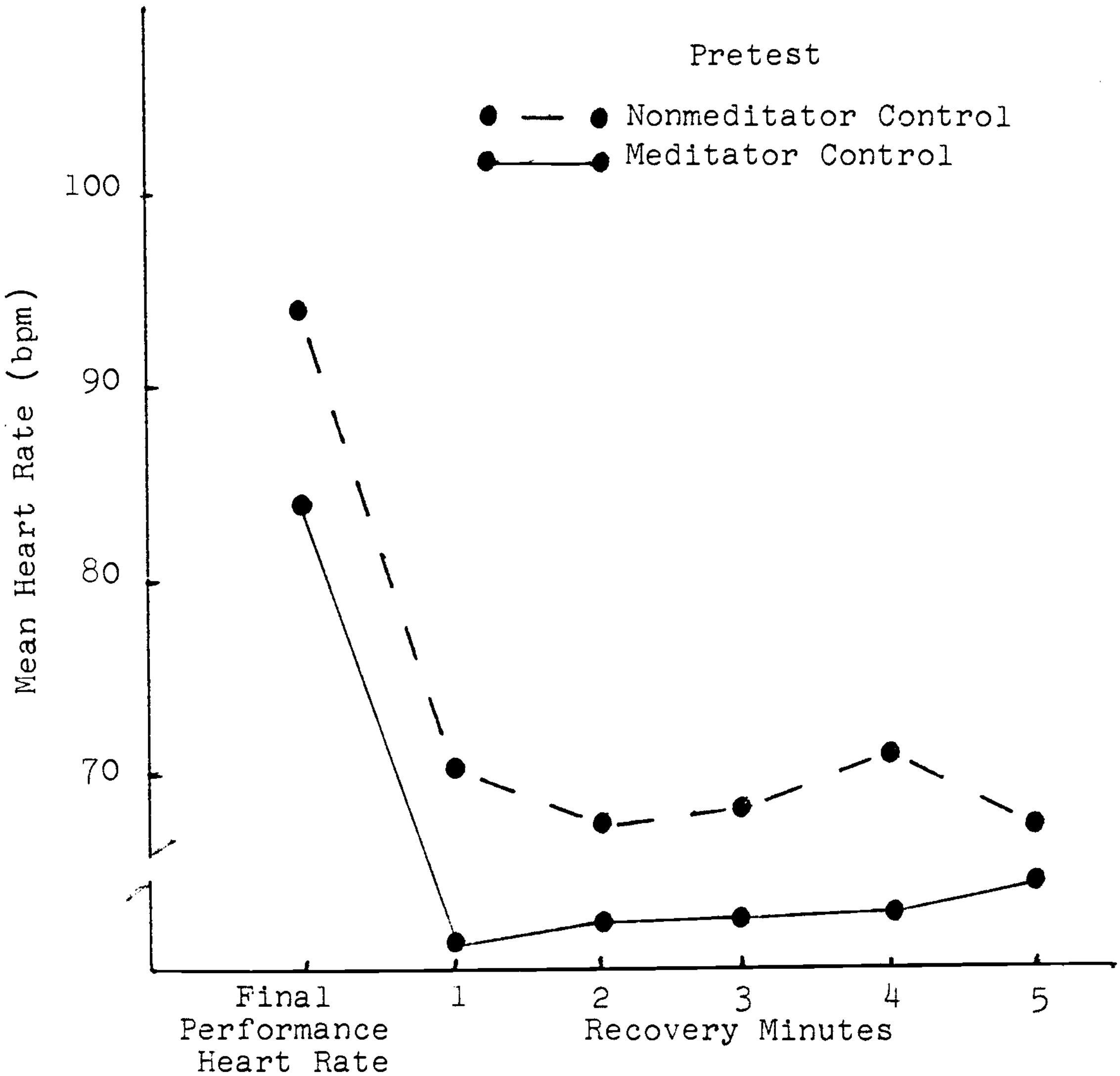

Figure 13c

Pursuit Rotor Heart Rate Response Comparing Meditator and Nonmeditator Control Groups During the Final Performance Heart Rate Through Recovery of the Pretest.

TABLE 5a

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR HEART RATE RESPONSE
COMPARING MEDITATOR AND NONMEDITATOR CONTROL GROUPS
DURING ADAPTATION/ANTICIPATION OF EACH TRIAL OF THE PRETEST

Source of Variation	Mean Square	Df	F-Ratio
Total	233.53	95	
Meditator/ Nonmeditator	1018.30	15	
	3278.34	1	3.83
Error	856.86	14	
Time Period	86.38	80	
	672.29	5	13.81*
Linear	894.64	1	21.29**
Quadratic	992.58	1	58.66**
Cubic	1254.79	1	15.52**
Quartic	105.11	1	1.85
Interaction	28.49	5	0.59
Linear	17.75	1	0.42
Quadratic	85.51	1	5.05**
Cubic	12.40	1	0.15
Quartic	4.93	1	0.09
Error	48.67	70	
Linear	42.02	14	
Quadratic	16.92	14	
Cubic	80.85	14	
Quartic	56.79	14	

*F of 2.38 needed for significance at .05 for df 5,70
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 5b

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR HEART RATE RESPONSE
COMPARING MEDITATOR AND NONMEDITATOR EXPERIMENTAL GROUPS
DURING THE SIXTH 10-SECOND PERIOD OF EACH TRIAL
OF THE POSTTEST

Source of Variation	Mean Square	Df	F-Ratio
Total	178.81	79	
Meditator/ Nonmeditator	893.40	15	
	145.80	1	0.15
Error	946.80	14	
Time Period	11.33	64	
	21.86	4	2.35
Linear	65.03	1	5.17*
Quadratic	5.79	1	0.43
Cubic	6.01	1	1.15
Quartic	10.61	1	1.79
Interaction	28.96	4	3.11
Linear	44.10	1	3.51
Quadratic	9.45	1	0.70
Cubic	3.31	1	0.63
Quartic	58.97	1	9.93*
Error	9.31	56	
Linear	12.58	14	
Quadratic	13.52	14	
Cubic	5.21	14	
Quartic	5.94	14	

*F of 4.60 needed for significance at .05 for df 1,14

TABLE 5c

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR HEART RATE RESPONSE
COMPARING MEDITATOR AND NONMEDITATOR CONTROL GROUPS
DURING FINAL PERFORMANCE HEART RATE THROUGH RECOVERY
OF THE PRETEST

Source of Variation	Mean Square	Df	F-Ratio
Total	173.62	95	
Meditator/ Nonmeditator	524.18	15	
	1141.26	1	2.38
Error	480.11	14	
Time Period	107.89	80	
	1466.89	5	90.18*
Linear	2825.75	1	107.56**
Quadratic	2835.05	1	120.47**
Cubic	1450.67	1	130.96**
Quartic	180.04	1	20.15**
Interaction	31.69	5	1.95
Linear	89.72	1	3.42
Quadratic	0.05	1	0.01
Cubic	22.05	1	1.99
Quartic	46.29	1	5.18**
Error	16.27	70	
Linear	26.27	14	
Quadratic	23.53	14	
Cubic	11.08	14	
Quartic	8.94	14	

*F of 2.38 needed for significance at .05 for df 5,70
**F of 4.60 needed for significance at .05 for df 1,14

Table 6 provides F-ratios and descriptions of significant trend difference found in heart rate response between experimental and control groups. Figures 14a through 14c illustrate difference in trends presented in Table 6. Analysis of variance tables are provided for each significant trend difference (Tables 7a through 7c).

Comparing meditators in the experimental and control conditions, a quartic differnce in trends was found in the pretest during the adaptation/anticipation time period, but not during the posttest. Nonmeditators in experimental and control groups were found to have a significant linear difference in trends of the fourth second period of each trial during the pretest but not during the posttest. Comparing experimental and control conditions, nonmeditators during the posttest showed a significant linear difference in trends during the second 10 second period of each trial.

TABLE 6

SIGNIFICANT* COMPARISONS OF TREND OF HEART RATE RESPONSE TO THE PURSUIT ROTOR TASK BETWEEN EXPERIMENTAL AND CONTROL GROUPS

	Adaptation/ Anticipation of Each Trial	Second 10-second Period of Each Trial	Fourth 10-second Period of Each Trial	Sixth 10-second Period of Each Trial	Final Performance Heart Rate/ of Each Trial
Meditator					
Pretest	quartic F 9.14				
Posttest					
Nonmeditator					
Pretest			linear F 8.11		
Posttest		linear F 4.92			

*F of 4.60 needed for significance at .05 for df 1,14

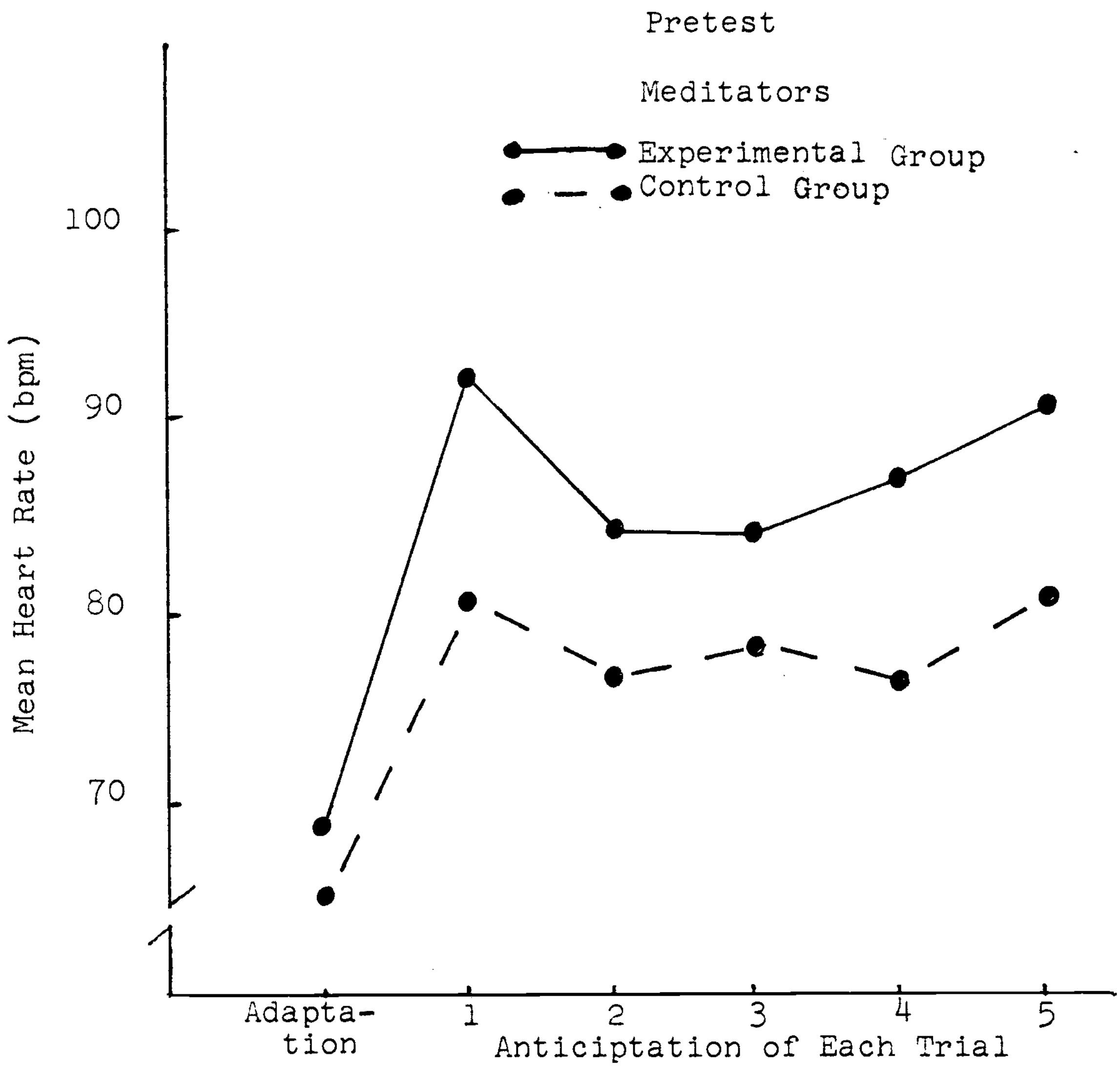

Figure 14a

Pursuit Rotor Heart Rate Response Comparing Experimental and Control Groups of Meditators During Adaptation and the Anticipation of Each Trial of the Pretest.

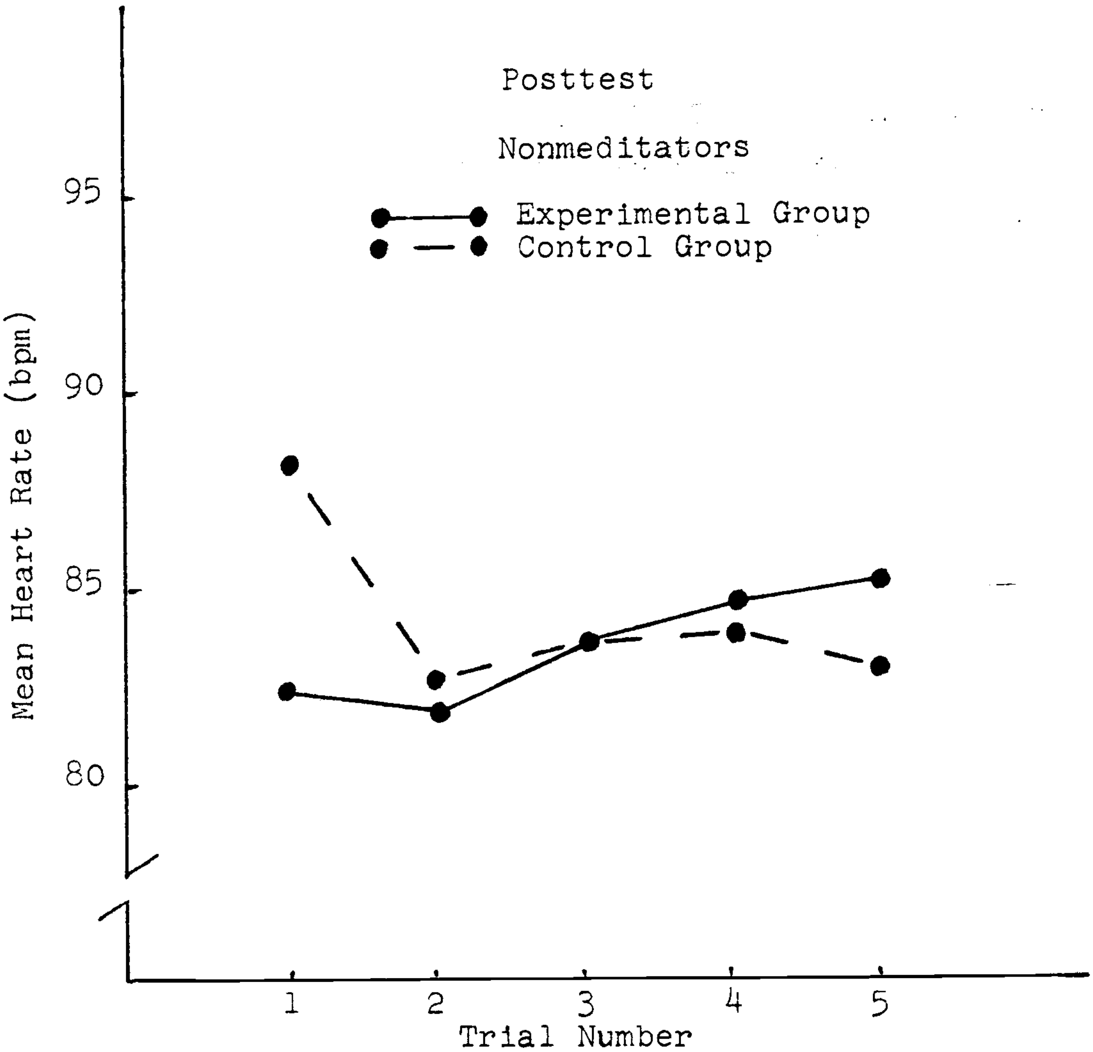

Figure 14b

Pursuit Rotor Heart Rate Response Comparing Experimental and Control Groups of Nonmeditators During the Second 10-Second Period of Each Trial of the Posttest.

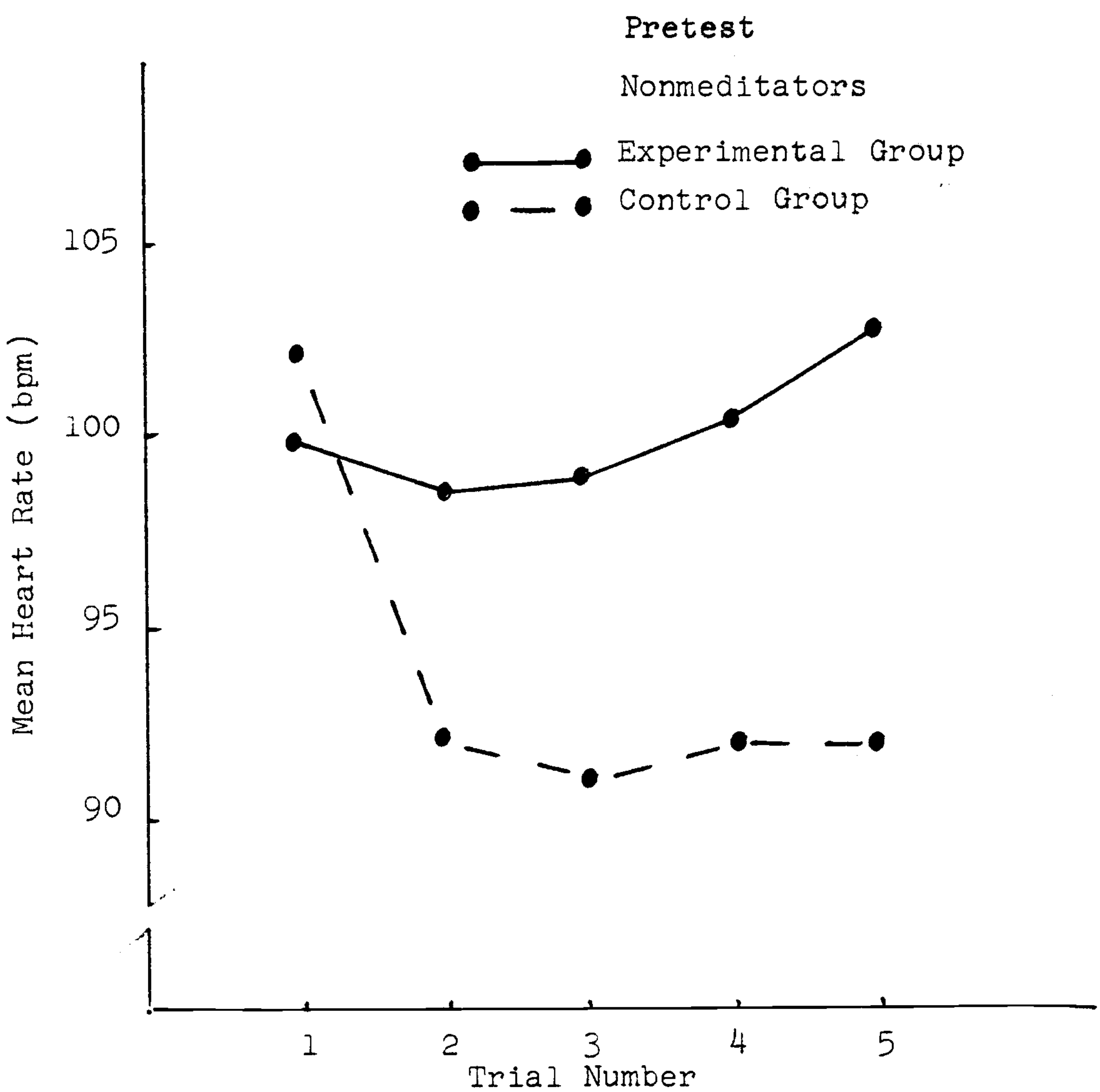

Figure 14c

Pursuit Rotor Heart Rate Response Comparing Experimental and Control Groups of Nonmeditators During the Fourth 10-Second Period of Each Trial of the Pretest.

TABLE 7a

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR HEART RATE RESPONSE
COMPARING EXPERIMENTAL AND CONTROL GROUPS OF MEDITATORS
DURING ADAPTATION/ANTICIPATION OF EACH TRIAL OF THE PRETEST

Source of Variation	Mean Square	Df	F-Ratio
Total	226.23	95	
Experimental/ Control	937.68	15	
	1658.34	1	1.87
Error	886.20	14	
Time Period	92.83	80	
	837.37	5	19.03*
Linear	1492.72	1	14.96**
Quadratic	540.10	1	16.69**
Cubic	1470.61	1	36.94**
Quartic	493.08	1	47.57**
Interaction	32.02	5	0.73
Linear	20.36	1	0.20
Quadratic	0.96	1	0.03
Cubic	41.57	1	1.04
Quartic	94.72	1	9.14**
Error	43.99	70	
Linear	99.78	14	
Quadratic	33.78	14	
Cubic	39.81	14	
Quartic	10.37	14	

*F of 2.38 needed for significance at .05 for df 5,70
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 7b

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR HEART RATE RESPONSE
COMPARING EXPERIMENTAL AND CONTROL GROUPS OF NONMEDITATORS
DURING THE SECOND 10-SECOND PERIOD OF EACH TRIAL
OF THE POSTTEST

Source of Variation	Mean Square	Df	F-Ratio
Total	196.00	79	
Experimental/ Control	974.34	15	
	11.25	1	0.01
Error	1043.14	14	
Time Period	13.58	64	
	19.51	4	1.67
Linear	0.01	1	0.01
Quadratic	27.86	1	2.54
Cubic	47.31	1	6.41*
Quartic	2.90	1	0.48
Interaction	33.78	4	2.89
Linear	110.56	1	4.92*
Quadratic	14.50	1	1.32
Cubic	9.51	1	1.29
Quartic	0.56	1	0.09
Error	11.71	56	
Linear	22.45	14	
Quadratic	10.96	14	
Cubic	7.38	14	
Quartic	6.04	14	

*F of 4.60 needed for significance at .05 for df 1,14

TABLE 7c

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR HEART RATE RESPONSE
COMPARING EXPERIMENTAL AND CONTROL GROUPS OF NONMEDITATORS
DURING THE FOURTH 10-SECOND PERIOD OF EACH TRIAL
OF THE PRETEST

Source of Variation	Mean Square	Df	F-Ratio
Total	449.80	79	
Experimental/ Control	2226.00	15	
	806.45	1	0.35
Error	2327.40	14	
Time Period	33.50	64	
	98.28	4	4.07*
Linear	63.76	1	1.63
Quadratic	285.75	1	12.43**
Cubic	43.06	1	1.68
Quartic	.56	1	0.06
Interaction	99.98	4	4.14*
Linear	316.41	1	8.11**
Quadratic	57.00	1	2.48
Cubic	26.41	1	1.03
Quartic	.11	1	0.01
Error	24.12	56	
Linear	39.14	14	
Quadratic	22.98	14	
Cubic	25.56	14	
Quartic	8.92	14	

*F of 2.55 needed for significance at .05 for df 4,56
**F of 4.60 needed for significance at .05 for df 1,14

Table 8 provides F-ratios and descriptions of significant trend difference found in heart rate response comparing pretest to posttest for each group. Figures 15a through 15f illustrate difference in trends presented in Table 8. Analysis of variance tables are provided for each significant trend difference (Tables 9a through 9f).

Control nonmeditators compared pretest to posttest showed a significant difference in three time periods: a quadratic trend difference during the second 10 second period of each trial, a linear difference during the fourth 10 second period of each trial, and a cubic difference during the sixth 10 second period of each trial. During the adaptation/anticipation time period experimental meditators and control meditators compared pretest to posttest showed a quartic difference in trends of heart rate response. A significant difference was found at the quartic degree comparing experimental meditators pretest to posttest during the sixth 10 second period of each trial.

TABLE 2.6

SIGNIFICANT*COMPARISONS OF TREND OF HEART RATE RESPONSE TO THE PURSUIT ROTOR TASK BETWEEN PRETEST AND POSTTEST

	Adaptation/ Anticipation of Each Trial	Second 10-second Period of Each Trial	Fourth 10-second Period of Each Trial	Sixth 10-second Period of Each Trial	Final Performance Heart Rate/ of Each Trial
Meditator					
Experimental	quartic F 6.00			quartic F 6.37	
Control	quartic F 5.06				
Nonmeditator					
Experimental					
Control		quadratic F 9.25	linear F 6.10	cubic F 6.43	

*F of 4.60 needed for significance at .05 for df 1,14

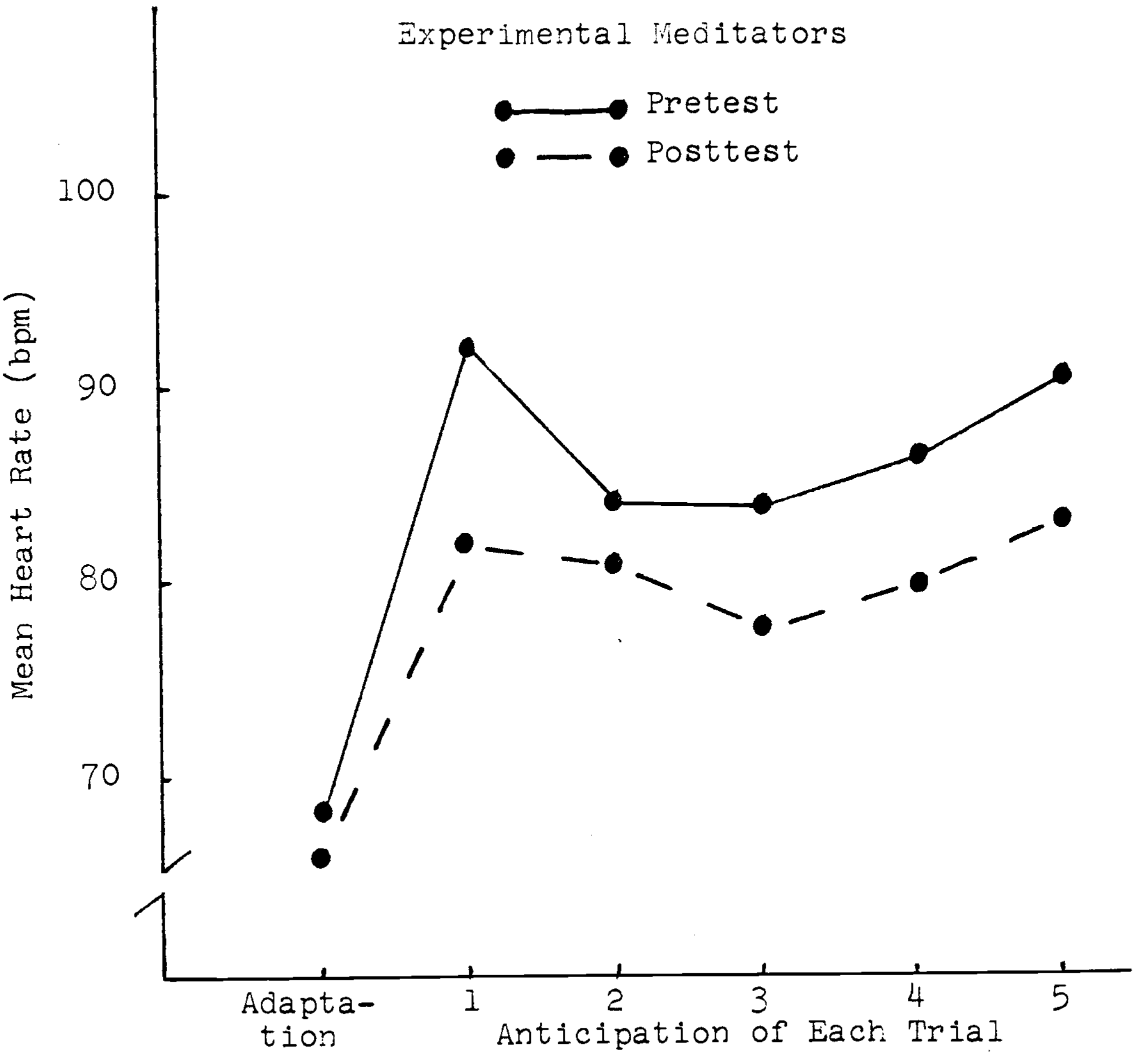

Figure 15a

Pursuit Rotor Heart Rate Response Comparing Pretest and Posttest of Meditators in the Experimental Group During Adaptation and the Anticipation of Each Trial.

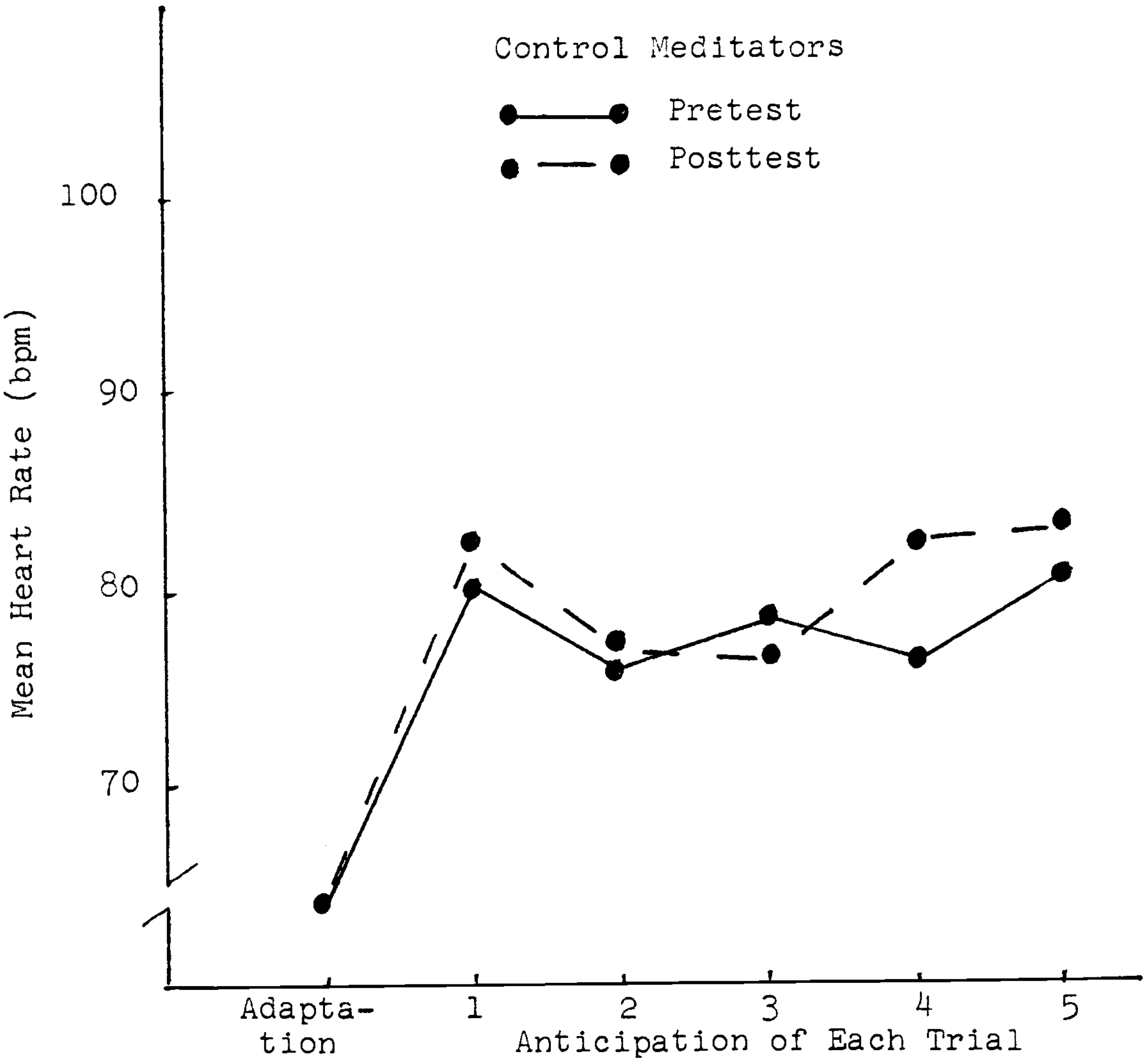

Figure 15b

Pursuit Rotor Heart Rate Response Comparing Pretest and Posttest of Meditators in the Control Group During Adaptation and the Anticipation of Each Trial.

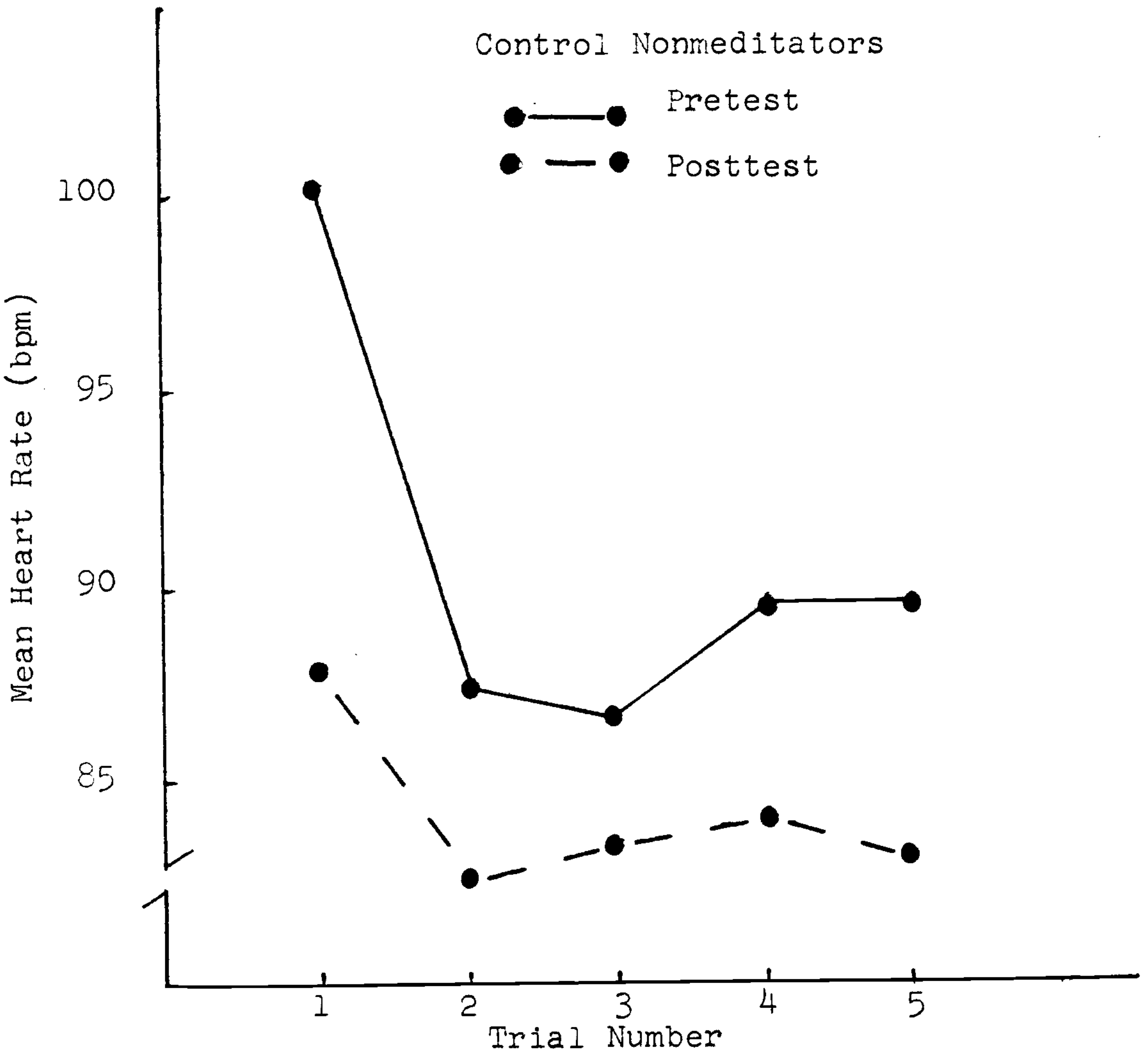

Figure 15c

Pursuit Rotor Heart Rate Response Comparing Pretest and Posttest of Nonmeditators in the Control Group During the Second 10-Second Period of Each Trial.

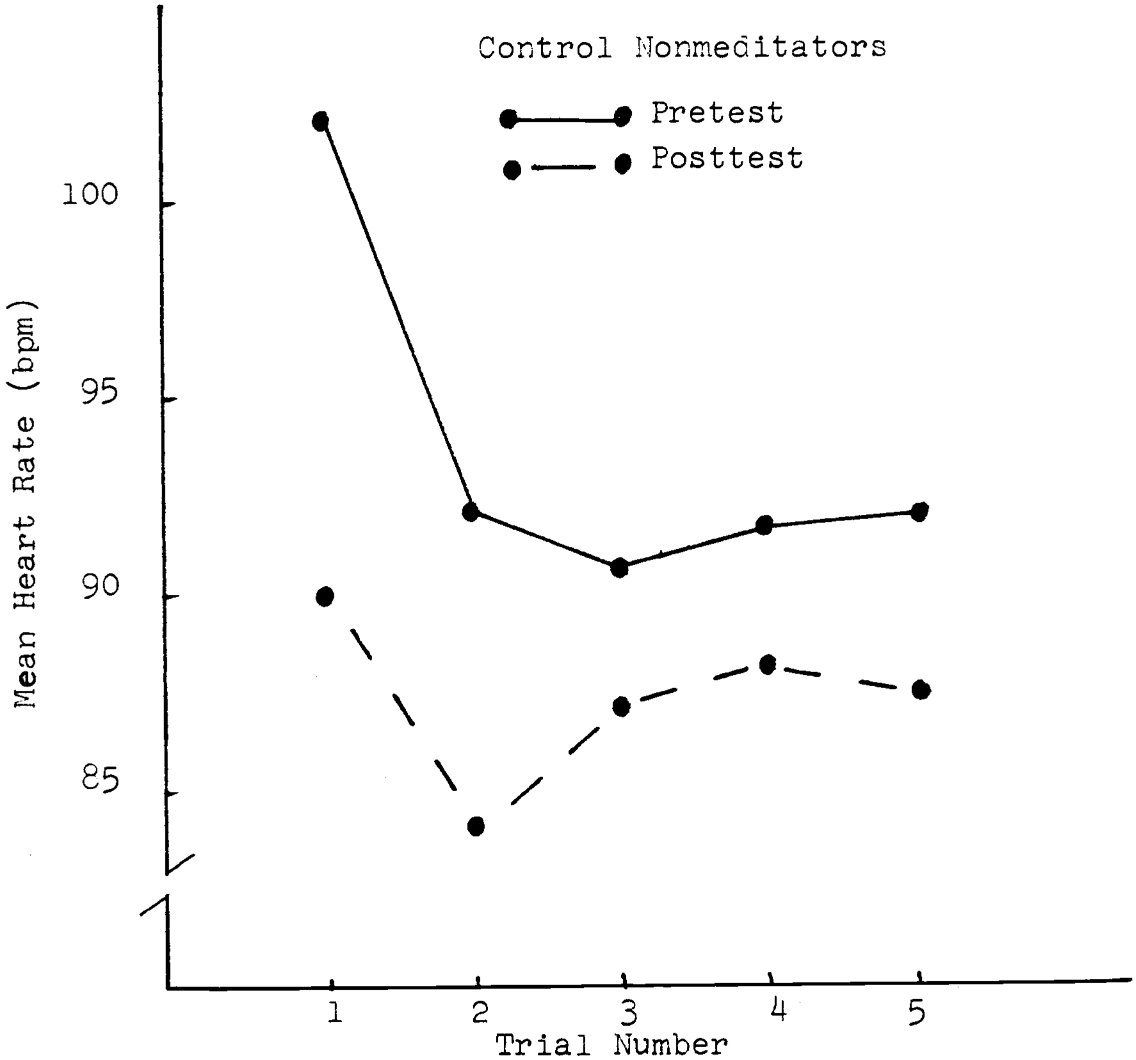

Figure 15d

Pursuit Rotor Heart Rate Response Comparing Pretest and Posttest of Nonmeditators in the Control Group During the Fourth 10-Second Period of Each Trial.

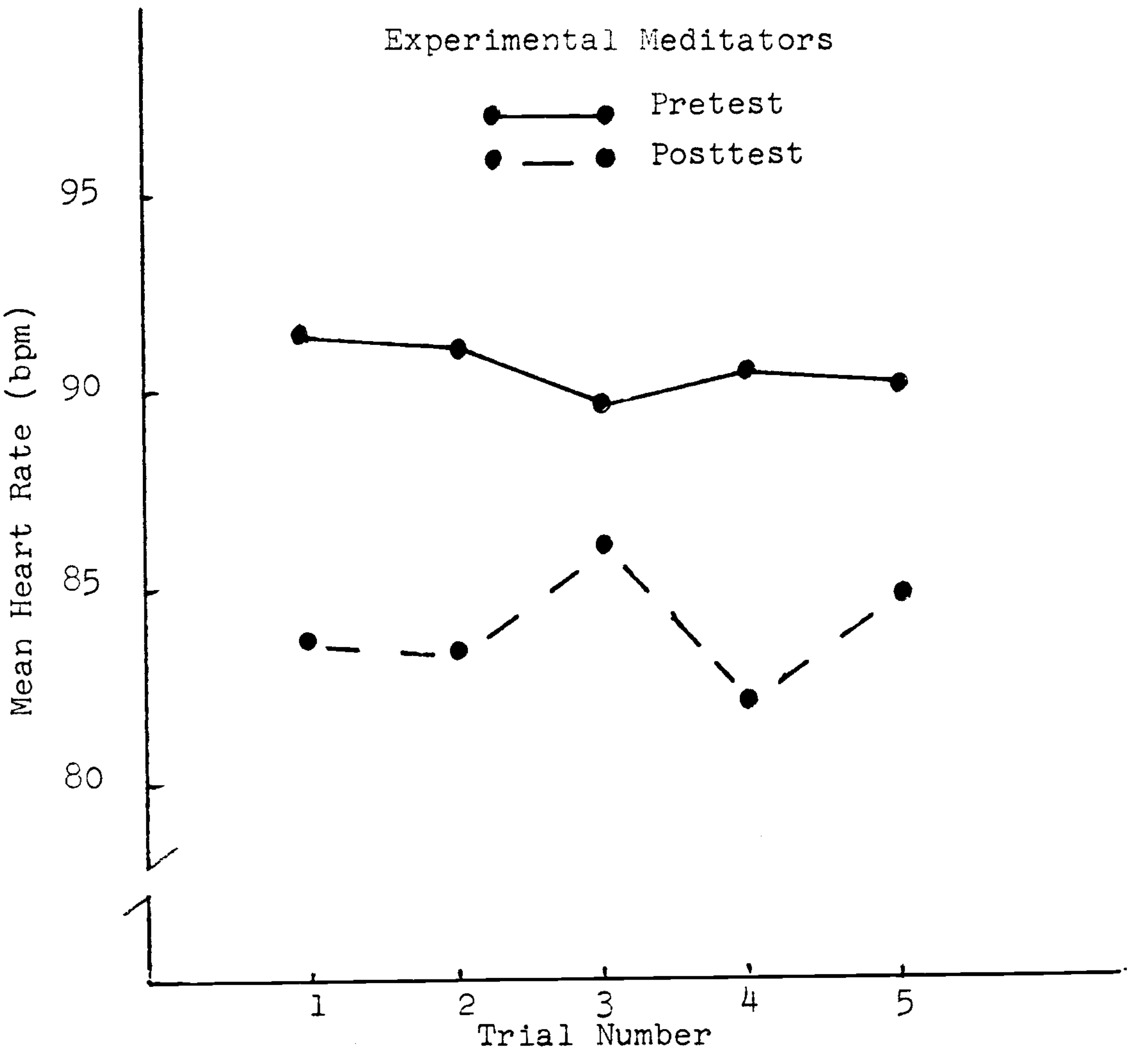

Figure 15e

Pursuit Rotor Heart Rate Response Comparing Pretest and Posttest of Meditators in the Experimental Group During the Sixth 10-Second Period of Each Trial

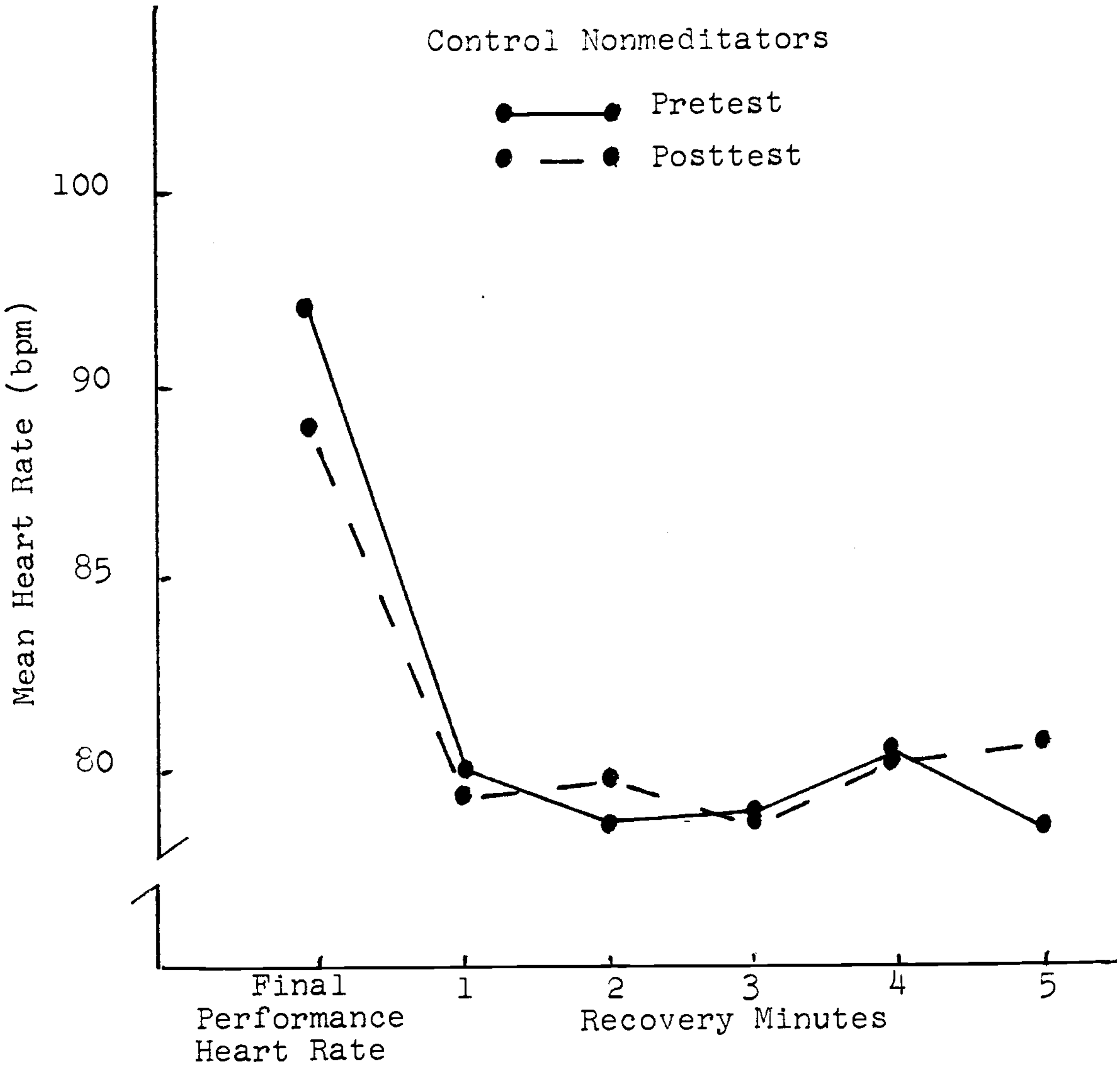

Figure 15f

Pursuit Rotor Heart Rate Response Comparing Pretest and Posttest of Nonmeditators in the Control Group During the Final Performance Heart Rate Through Recovery

TABLE 9a

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR HEART RATE RESPONSE
COMPARING PRETEST AND POSTTEST
OF MEDITATORS IN THE EXPERIMENTAL GROUP
DURING ADAPTATION/ANTICIPATION OF EACH TRIAL

Source of Variation	Mean Square	Df	F-Ratio
Total	295.41	95	
Pretest/ Posttest	1262.06	15	
	852.04	1	0.66
Error	1291.35	14	
Time Period	114.16	80	
	848.82	5	12.60*
Linear	1476.60	1	11.76**
Quadratic	542.65	1	14.09**
Cubic	1689.74	1	35.40**
Quartic	505.75	1	34.00**
Interaction	34.47	5	0.51
Linear	22.29	1	0.18
Quadratic	0.86	1	0.02
Cubic	13.61	1	0.29
Quartic	89.29	1	6.00**
Error	67.38	70	
Linear	125.55	14	
Quadratic	38.52	14	
Cubic	47.73	14	
Quartic	14.88	14	

*F of 2.50 needed for significance at .05 for df 5,70
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 9b

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR HEART RATE RESPONSE
COMPARING PRETEST AND POSTTEST
OF MEDITATORS IN THE CONTROL GROUP
DURING ADAPTATION/ANTICIPATION OF EACH TRIAL

Source of Variation	Mean Square	Df	F-Ratio
Total	117.22	95	
Pretest/ Posttest	418.33	15	
	66.67	1	0.15
Error	443.45	14	
Time Period	60.76	80	
	669.09	5	34.00*
Linear	1513.58	1	49.57**
Quadratic	394.33	1	28.69**
Cubic	891.11	1	41.94**
Quartic	448.00	1	30.02**
Interaction	27.62	5	1.40
Linear	22.86	1	0.75
Quadratic	5.76	1	0.42
Cubic	4.20	1	0.29
Quartic	75.57	1	5.06**
Error	19.68	70	
Linear	30.53	14	
Quadratic	13.74	14	
Cubic	21.25	14	
Quartic	14.92	14	

*F of 2.50 needed for significance at .05 for df 5,70
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 9c

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR HEART RATE RESPONSE
COMPARING PRETEST AND POSTTEST
OF NONMEDITATORS IN THE CONTROL GROUP
DURING THE SECOND 10-SECOND PERIOD OF EACH TRIAL

Source of Variation	Mean Square	Df	F-Ratio
Total	237.45	79	
Pretest/ Posttest	1120.48	15	
	832.10	1	0.73
Error	1141.08	14	
Time Period	30.49	64	
	225.50	4	14.56*
Linear	297.03	1	11.56**
Quadratic	391.14	1	31.65**
Cubic	211.60	1	17.81**
Quartic	2.23	1	0.19
Interaction	45.61	4	2.95
Linear	46.23	1	1.80
Quadratic	114.29	1	9.25**
Cubic	21.03	1	1.77
Quartic	.91	1	0.08

*F of 2.55 needed for significance at .05 for df 4,56
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 9d

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR HEART RATE RESPONSE
COMPARING PRETEST AND POSTTEST
OF NONMEDITATORS IN THE CONTROL GROUP
DURING THE FOURTH 10-SECOND PERIOD OF EACH TRIAL

Source of Variation	Mean Square	Df	F-Ratio
Total	221.96	79	
Pretest/ Posttest	1048.36	15	
	825.61	1	0.78
Error	1064.27	14	
Time Period	28.28	64	
	157.23	4	9.19*
Linear	180.63	1	7.24**
Quadratic	274.57	1	17.23**
Cubic	160.00	1	7.80**
Quartic	13.73	1	1.94
Interaction	55.52	4	3.24
Linear	152.10	1	6.10**
Quadratic	62.16	1	3.90
Cubic	0.90	1	0.14
Quartic	6.91	1	0.98
Error	17.12	56	
Linear	24.93	14	
Quadratic	15.94	14	
Cubic	20.52	14	
Quartic	7.08	14	

*F of 2.55 needed for significance at .05 for df 4,56
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 9e

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR HEART RATE RESPONSE
COMPARING PRETEST AND POSTTEST
OF MEDITATORS IN THE EXPERIMENTAL GROUP
DURING THE SIXTH 10-SECOND PERIOD OF EACH TRIAL

Source of Variation	Mean Square	Df	F-Ratio
Total	178.08	79	
Pretest/ Posttest	861.97	15	
	858.05	1	1.00
Error	862.25	14	
Time Period	17.79	64	
	4.80	4	0.26
Linear	1.23	1	0.03
Quadratic	0.64	1	0.05
Cubic	4.90	1	1.04
Quartic	12.43	1	1.44
Interaction	16.93	4	0.90
Linear	6.40	1	0.13
Quadratic	2.16	1	0.16
Cubic	4.23	1	0.90
Quartic	54.91	1	6.37*
Error	18178	56	
Linear	48.51	14	
Quadratic	13.25	14	
Cubic	4.72	14	
Quartic	8.63	14	

*F of 4.60 needed for signficance of .05 for df 1,14

TABLE 9f

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR HEART RATE RESPONSE
COMPARING PRETEST AND POSTTEST
OF NONMEDITATORS IN THE CONTROL GROUP
DURING THE FINAL PERFORMANCE HEART RATE THROUGH RECOVERY

Source of Variation	Mean Square	Df	F-Ratio
Total	191.35	95	
Pretest/ Posttest	618.72	15	
	1.50	1	0.01
Error	662.81	14	
Time Period	111.21	80	
	1280.12	5	40.08*
Linear	2532.01	1	60.40**
Quadratic	2568.57	1	35.22**
Cubic	1130.01	1	86.50**
Quartic	100.32	1	5.58**
Interaction	52.10	5	1.63
Linear	151.56	1	3.62
Quadratic	7.74	1	0.11
Cubic	84.05	1	6.43**
Quartic	11.57	1	0.64
Error	31.94	70	
Linear	41.92	14	
Quadratic	72.92	14	
Cubic	13.06	14	
Quartic	17.99	14	

*F of 2.38 needed for significance at .05 for df 5,70
**F of 4.60 needed for significance at .05 for df 1,14

Blood Pressure. No significant difference in trends of blood pressure response was found between meditators and nonmeditators, in experimental or control conditions, pretest or posttest, in any of the selected time periods for the pursuit rotor task. Table 10 provides mean blood pressure responses during time periods for each group.

TABLE 10

MEAN BLOOD PRESSURE RESPONSE* TO THE PURSUIT ROTOR TASK

Groups	Anticipation	Intervals Between Trials 1	2	3	4	5	Recovery
Meditators							
Experimental							
Pretest	101	110	111	112	111	112	108
Posttest	101	107	107	110	109	109	103
Control							
Pretest	104	98	99	100	99	112	106
Posttest	100	106	108	108	110	108	101
Nonmeditators							
Experimental							
Pretest	108	114	113	113	115	114	105
Posttest	114	112	113	113	111	111	105
Control							
Pretest	111	121	120	120	117	116	108
Posttest	107	112	115	114	117	112	108

*indicated in mm Hg

Frontalis EMG. No significant difference was found in the analysis of trends of frontalis EMG values between meditators and nonmeditators, in experimental or control conditions, pretest or posttest, in any of the selected time periods for the pursuit rotor task. Tables 11a and 11b provide mean frontalis EMG responses during time periods for each group.

TABLE 11a

MEAN FRONTALIS EMG RESPONSE* TO THE PURSUIT ROTOR TASK DURING ADAPTATION AND PERFORMANCE OF EACH TRIAL

	Adaptation	Trial 1	2	3	4	5
Meditator						
Experimental						
Pretest	6.1	4.6	4.7	4.8	4.8	4.8
Posttest	4.1	4.9	5.3	5.2	5.2	5.0
Control						
Pretest	4.2	3.8	3.7	3.7	3.6	3.7
Posttest	4.2	4.3	4.0	3.9	3.9	3.8
Nonmeditator						
Experimental						
Pretest	5.6	4.8	4.5	4.5	4.3	4.3
Posttest	4.0	4.8	4.6	4.7	4.6	4.6
Control						
Pretest	4.2	3.8	3.7	3.6	3.6	3.6
Posttest	3.7	3.6	3.5	3.6	3.5	3.3

*indicated in integrated one-minute averages measured in microvolts

TABLE 11b

MEAN FRONTALIS EMG RESPONSE* TO THE PURSUIT ROTOR TASK DURING TRIAL 5 THROUGH RECOVERY

	Trial	Recovery				
	5	1	2	3	4	5
Meditators						
Experimental						
Pretest	4.8	4.9	4.2	5.2	4.9	5.4
Posttest	5.0	4.6	4.5	4.2	4.5	4.6
Control						
Pretest	3.7	3.6	3.5	3.9	4.0	3.9
Posttest	3.8	3.6	3.2	3.1	3.2	3.6
Nonmeditators						
Experimental						
Pretest	4.3	4.5	4.1	4.4	4.3	4.5
Posttest	4.6	4.0	3.6	3.7	3.9	5.9
Control						
Pretest	3.6	3.9	3.8	4.2	3.9	4.3
Posttest	3.3	3.7	3.5	3.5	3.4	3.7

*indicated in integrated one-minute averages measured in microvolts

Bicycle Task

The bicycle ergometer was chosen as an instrument to measure gross motor task involving large muscle groups and a cardiovascular endurance response.

Selected time periods were analyzed for the bicycle, as for the pursuit rotor, on the assumption the pattern of activated physiological response or physiological habituation might occur in certain time periods and not in others. Since the length of performance varied from seven to 20 minutes among subjects in the bicycle task, group means of repeated measures of the physiological variables during performance were derived using interpolated values based on 20 intervals. Actual scores for the bicycle task were used in comparisons made of data gathered prior to performance, during the first three minutes of performance, and during the recovery period. Time periods selected for the bicycle task data analysis were: adaptation through minute three of performance (four values), performance period (20 values), and the last performance measure through recovery (11 values).

Heart Rate. Tables 12a through 12b provide mean values for heart rate response for each group during each time period. Table 13 provides F-ratios and descriptions of significant trend difference found in heart rate response between meditators and nonmeditators. Figures 16a through 16e illustrate the difference in trends presented in Table 13 Analysis of variance tables are provided for each significant trend difference (Table 14a through 14e).

During the pretest analysis of meditators and nonmeditators in the experimental condition reflected a significant difference in trends of heart rate response during the time period described by the last performance heart rate through recovery. The difference was linear and cubic in description. The posttest analysis reflected a significant quadratic difference in trends between experimental meditators and nonmeditators during the performance period. No significant difference between meditators and nonmeditators was shown in the control condition.

TABLE 12a

MEAN HEART RATE RESPONSE* TO THE BICYCLE TASK
DURING ADAPTATION THROUGH MINUTE THREE OF PERFORMANCE

Groups	Adaptation	Anticipation	Minute 1	Minute 2	Minute 3
Meditators					
Experimental					
Pretest	68	77	97	92	92
Posttest	64	69	93	94	91
Control					
Pretest	62	70	94	95	93
Posttest	67	72	92	94	95
Nonmeditators					
Experimental					
Pretest	73	71	102	100	103
Posttest	67	74	97	94	95
Control					
Pretest	68	82	99	100	97
Posttest	69	75	97	97	98

*indicated in beats per minute

TABLE 12b

MEAN HEART RATE RESPONSE* TO THE BICYCLE TASK DURING PERFORMANCE

Interpolated Minutes of Performance	Meditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
1	89	84	84	82
2	95	91	93	89
3	94	91	94	93
4	94	93	94	94
5	98	97	95	96
6	98	99	95	99
7	102	102	100	101
8	106	106	104	103
9	111	108	107	106
10	113	109	109	109
11	117	113	113	112
12	121	118	118	117
13	125	123	122	122
14	128	127	125	126
15	131	131	129	131
16	136	136	134	136
17	141	140	139	140
18	145	145	144	145
19	150	149	149	150
20	155	155	154	156

*indicated in beats per minute, interpolated data

TABLE 12c

MEAN HEART RATE RESPONSE* TO THE BICYCLE TASK DURING PERFORMANCE

Interpolated Minutes of Performance	Nonmeditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
1	89	87	91	87
2	100	95	96	93
3	100	96	99	96
4	102	96	99	98
5	103	96	101	100
6	104	97	102	101
7	105	99	104	103
8	108	102	105	104
9	112	107	106	107
10	115	109	110	110
11	118	111	117	113
12	120	116	121	113
13	124	120	124	121
14	128	125	128	125
15	131	130	132	129
16	135	135	137	133
17	140	138	140	138
18	145	142	145	143
19	149	148	150	149
20	154	155	156	154

*indicated in beats per minute, interpolated data

TABLE 12d

MEAN HEART RATE RESPONSE* TO THE BICYCLE TASK DURING LAST PERFORMANCE HEART RATE THROUGH RECOVERY

	Meditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
Last Performance Heart Rate	154	154	154	155
Recovery Minute 1	120	117	114	112
Recovery Minute 2	99	96	88	87
Recovery Minute 3	91	87	77	81
Recovery Minute 4	86	90	77	85
Recovery Minute 5	88	87	77	77
Recovery Minute 6	83	85	74	78
Recovery Minute 7	80	81	76	79
Recovery Minute 8	82	81	74	78
Recovery Minute 9	80	81	73	77
Recovery Minute 10	82	81	77	79

*indicated in beats per minute

TABLE 12e

MEAN HEART RATE RESPONSE* TO THE BICYCLE TASK DURING LAST PERFORMANCE HEART RATE THROUGH RECOVERY

	Nonmeditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
Last Performance Heart Rate	153	154	156	154
Recovery Minute 1	117	116	116	111
Recovery Minute 2	91	83	95	89
Recovery Minute 3	89	79	87	87
Recovery Minute 4	88	85	84	82
Recovery Minute 5	88	83	84	81
Recovery Minute 6	84	82	83	80
Recovery Minute 7	85	83	81	80
Recovery Minute 8	87	81	78	80
Recovery Minute 9	84	79	83	77
Recovery Minute 10	81	80	83	79

*indicated in beats per minute

TABLE 13

SIGNIFICANT* COMPARISONS OF TREND
OF HEART RATE RESPONSE TO THE BICYCLE TASK
BETWEEN MEDITATORS AND NONMEDITATORS

	Adaptation/ Minute 3	Interpolated Performance	Last Performance Heart Rate/ Recovery
Meditators/ Nonmeditators			
Experimental			
Pretest			linear F 6.00
			cubic F 7.40
Posttest		quadratic F 4.65	
Control			
Pretest			
Posttest			

*F of 4.60 needed for significance at .05 for df 1,14

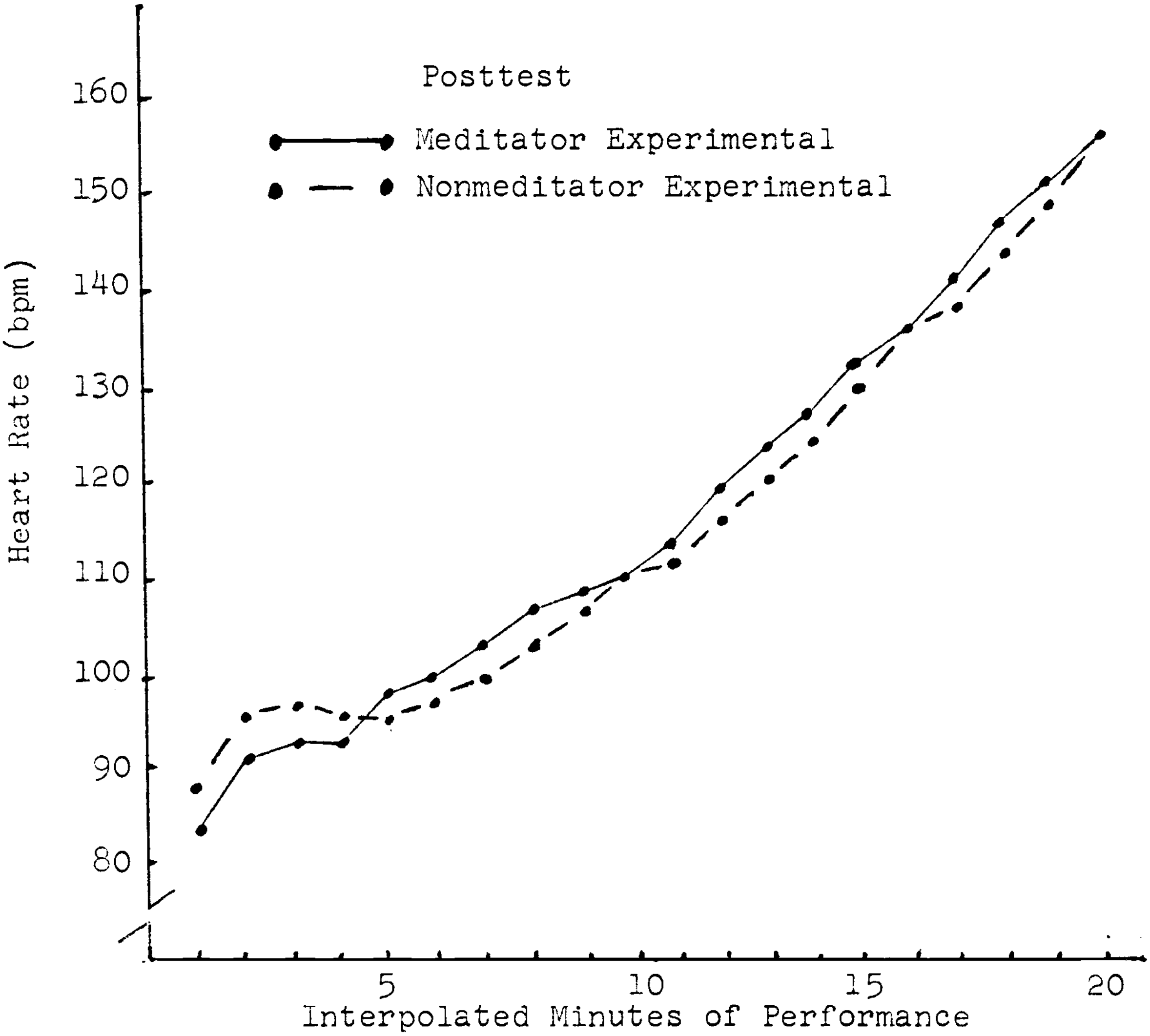

Figure 16a

Bicycle Heart Rate Response Comparing Meditator and Nonmeditator Experimental Groups During Performance of the Posttest

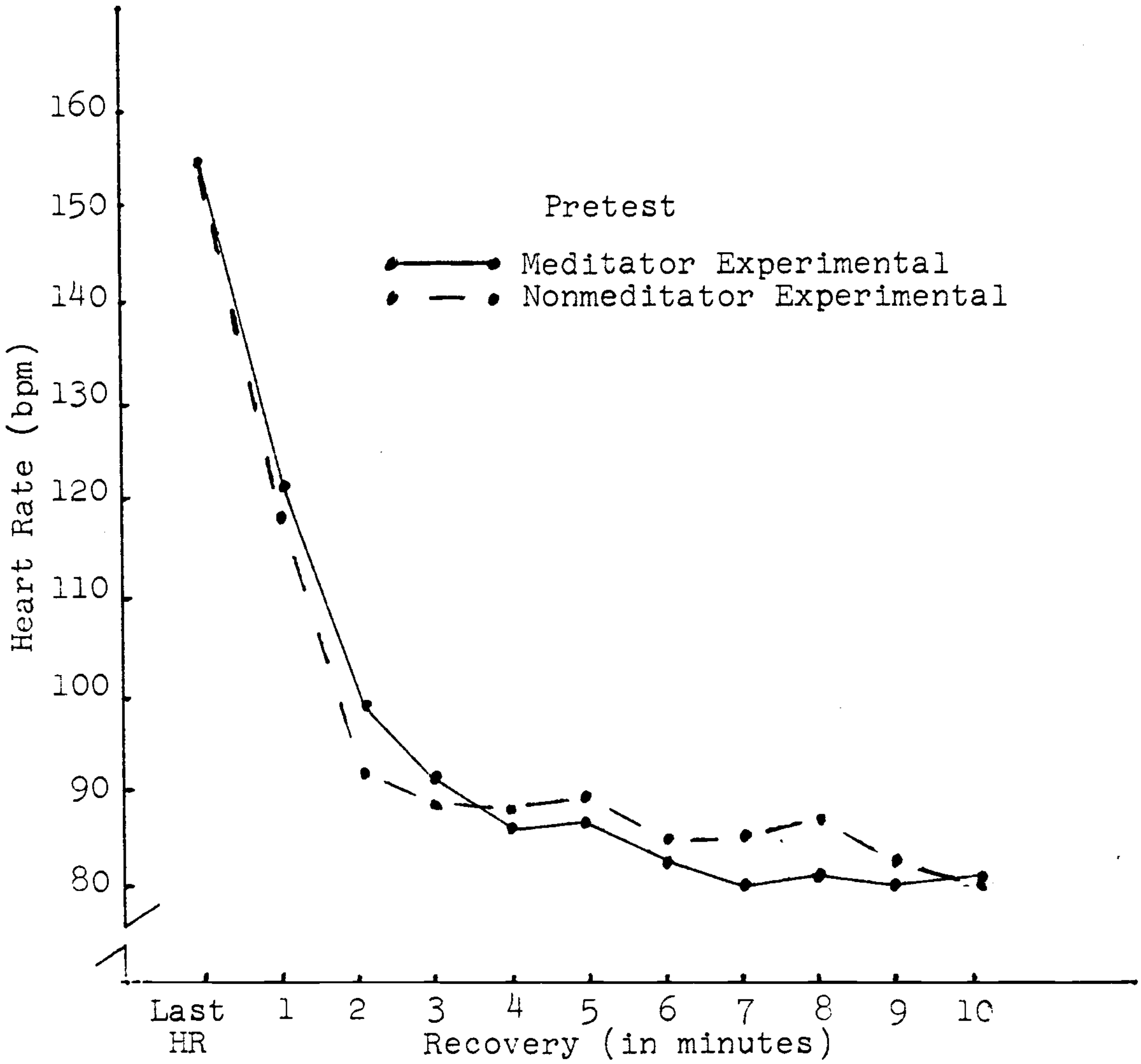

Figure 16b

Bicycle Heart Rate Response Comparing Meditator and Nonmeditator Experimental Groups During the Last Performance Heart Rate Through Recovery of the Pretest

TABLE 14a

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE HEART RATE RESPONSE
COMPARING MEDITATOR AND NONMEDITATOR EXPERIMENTAL GROUPS
DURING PERFORMANCE OF THE POSTTEST

Source of Variation	Mean Square	Df	F-Ratio
Total	476.89	319	
Meditator/ Nonmeditator	837.86	15	
	54.98	1	0.06
Error	893.78	14	
Time Period	459.08	304	
	6910.92	19	237.15*
Linear	127529.59	1	369.34**
Quadratic	3325.14	1	85.68**
Cubic	2.57	1	0.06
Quartic	110.41	1	2.35
Interaction	26.46	19	0.91
Linear	170.35	1	0.49
Quadratic	180.35	1	4.65**
Cubic	12.71	1	0.30
Quartic	0.11	1	0.01
Error	29.14	266	
Linear	345.29	14	
Quadratic	38.80	14	
Cubic	42.06	14	
Quartic	46.99	14	

*F of 1.59 needed for significance at .05 for df 19,266
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 14b

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE HEART RATE RESPONSE
COMPARING MEDITATOR AND NONMEDITATOR EXPERIMENTAL GROUPS
DURING THE LAST PERFORMANCE HEART RATE THROUGH RECOVERY
OF THE PRETEST

Source of Variation	Mean Square	Df	F-Ratio
Total	595.60	175	
Meditator/ Nonmeditator	1247.89	15	
	0.02	1	0.01
Error	1337.02	14	
Time Period	534.45	160	
	7938.16	10	199.54*
Linear	464741.42	1	1237.66**
Quadratic	22232.00	1	219.98**
Cubic	8224.62	1	271.02**
Quartic	1652.64	1	23.40**
Interaction	56.06	10	1.41
Linear	226.95	1	6.01**
Quadratic	11.19	1	0.11
Cubic	224.78	1	7.41**
Quartic	0.15	1	0.01
Error	39.78	140	
Linear	37.77	14	
Quadratic	101.06	14	
Cubic	30.35	14	
Quartic	70.63	14	

*F of 1.83 needed for significance at .05 for df 10,140
**F of 4.60 needed for significance at .05 for df 1,14

Table 15 provides F-ratios and descriptions of significant difference in trends found in heart rate response between experimental and control groups. Figures 17a and 17b illustrate the difference in trends presented in Table 15. Analysis of variance tables are provided for each significant differnce in trends (Tables 16a and 16b).

Experimental and control meditators showed a significant difference in trends during the last performance heart rate through recovery time period. During the pretest, results showed a quadratic and cubic difference, during the posttest a quadratic difference in trends was reflected in analysis. No significant difference was shown for nonmeditators between experimental and control conditions during any time period.

No significant difference was found between pretest and posttest trends of heart rate response for meditators or nonmeditators in the experimental or control condition.

TABLE 15

SIGNIFICANT* COMPARISONS OF TREND OF HEART RATE RESPONSE TO THE BICYCLE TASK BETWEEN EXPERIMENTAL AND CONTROL GROUPS

	Adaptation/ Minute 3	Interpolated Performance	Last Performance Heart Rate/ Recovery
Experimental/ Control			
Meditators			
Pretest			quadratic F 5.62
			cubic F 4.93
Posttest			quadratic F 6.45
Nonmeditators			
Pretest			
Posttest			

*F of 4.60 needed for significance at .05 for df 1,14

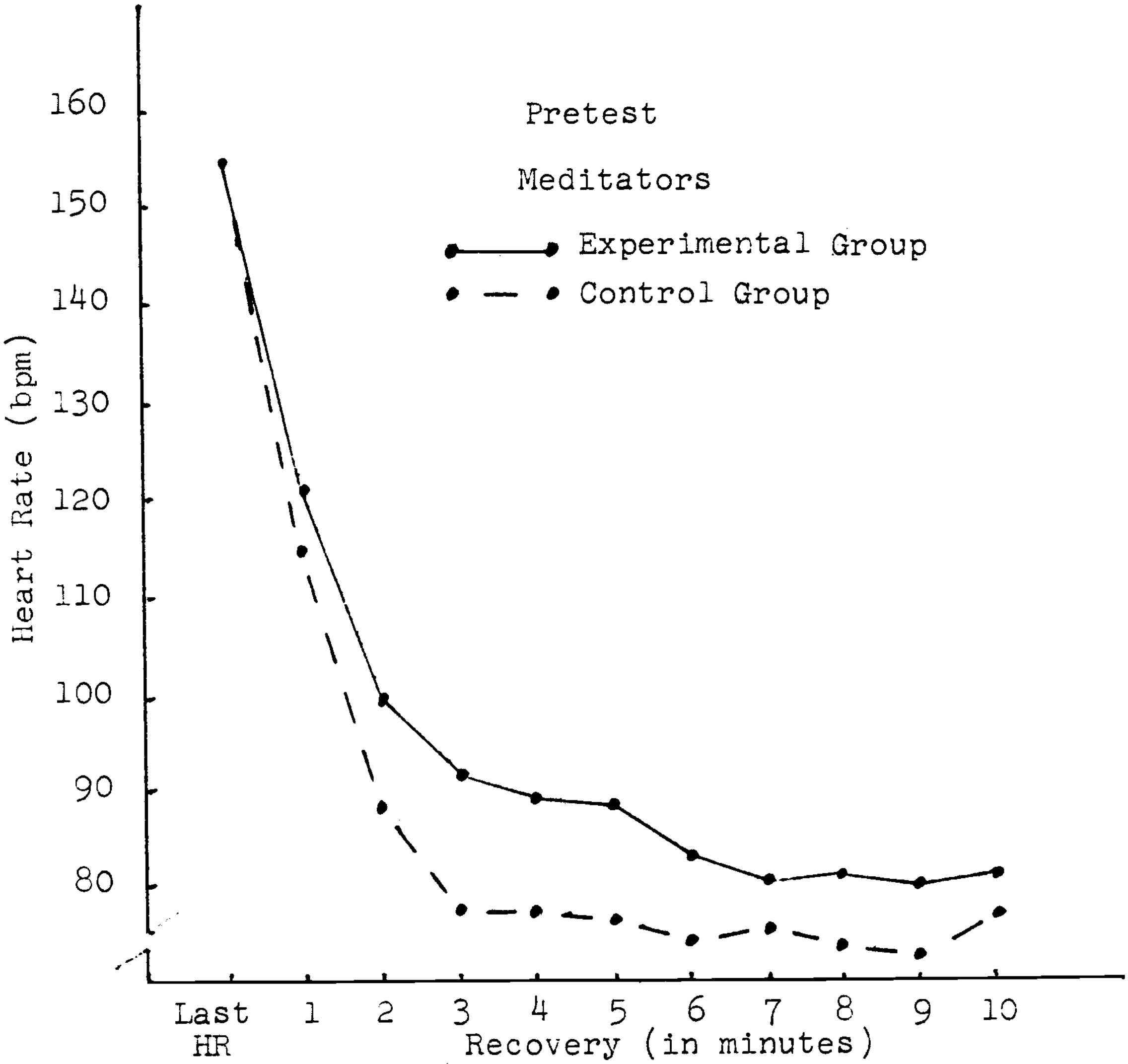

Figure 17a

Bicycle Heart Rate Response Comparing Experimental and Control Groups of Meditators During the Last Performance Heart Rate Through Recovery of the Pretest.

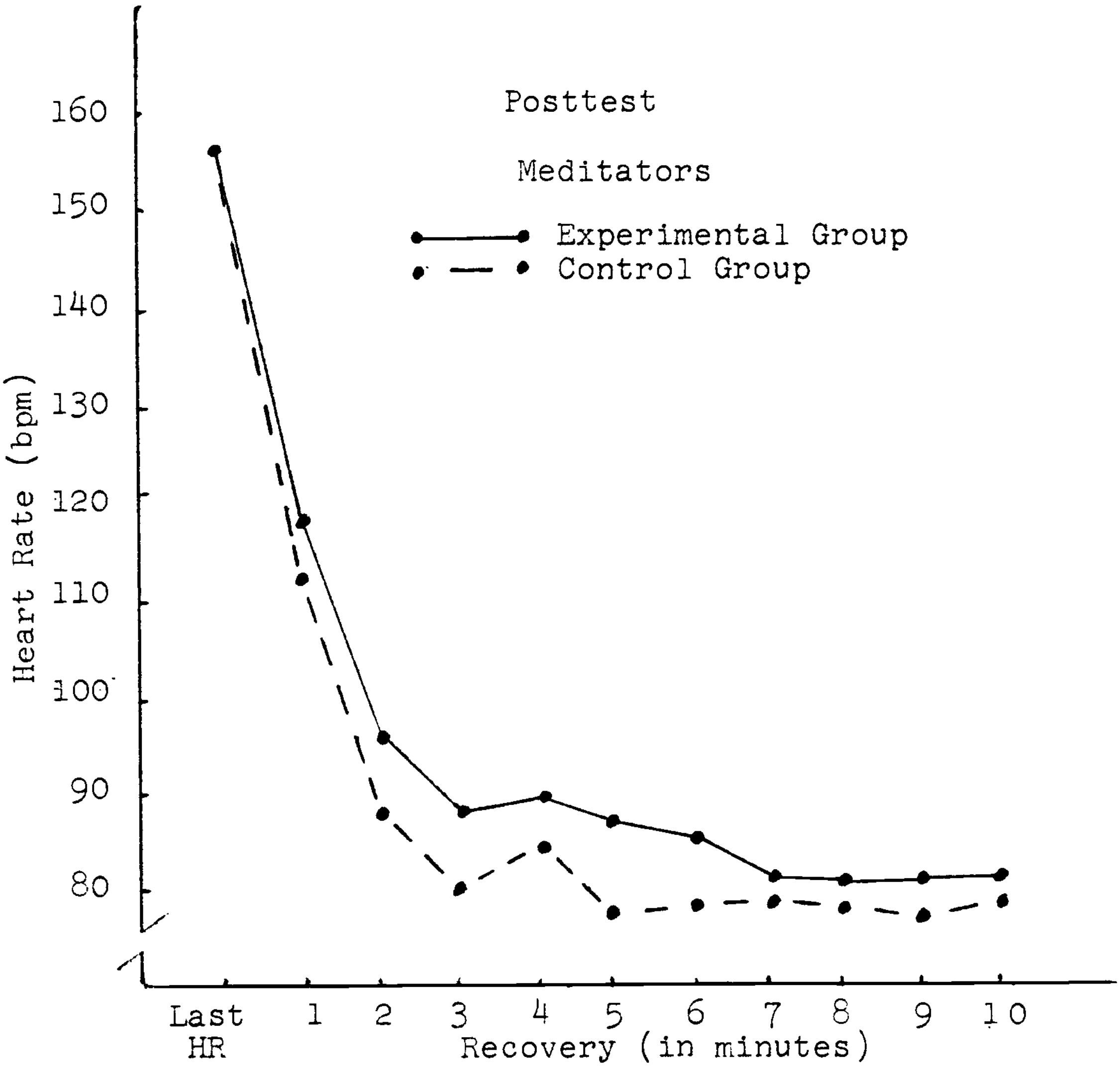

Figure 17b

Bicycle Heart Rate Response Comparing Experimental and Control Groups of Meditators During the Last Performance Heart Rate Through Recovery of the Posttest.

TABLE 16a

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE HEART RATE RESPONSE
COMPARING EXPERIMENTAL AND CONTROL GROUPS OF MEDITATORS
DURING THE LAST PERFORMANCE HEART RATE THROUGH RECOVERY
OF THE PRETEST

Source of Variation	Mean Square	Df	F-Ratio
Total	641.92	175	
Experimental/ Control	920.63	15	
	2752.36	1	3.48
Error	789.79	14	
Time Period	615.79	160	
	9216.03	10	223.98*
Linear	52888.58	1	1038.28**
Quadratic	29085.11	1	500.16**
Cubic	7938.56	1	217.96**
Quartic	2039.56	1	28.75**
Interaction	60.58	10	1.47
Linear	1.66	1	0.03
Quadratic	327.39	1	5.63**
Cubic	179.59	1	4.93**
Quartic	23.94	1	0.34
Error	41.15	140	
Linear	50.94	14	
Quadratic	58.15	14	
Cubic	36.42	14	
Quartic	70.95	14	

*F of 1.83 needed for significance at .05 for df 10,140
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 16b

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE HEART RATE RESPONSE
COMPARING EXPERIMENTAL AND CONTROL GROUPS OF MEDITATORS
DURING THE LAST PERFORMANCE HEART RATE THROUGH RECOVERY
OF THE POSTTEST

Source of Variation	Mean Square	Df	F-Ratio
Total	636.05	175	
Experimental/ Control	1110.34	15	
	1060.36	1	0.95
Error	1113.91	14	
Time Period	591.59	160	
	8741.05	10	179.98*
Linear	47600.80	1	412.52**
Quadratic	26962.35	1	891.62**
Cubic	9449.58	1	177.76**
Quartic	2870.06	1	42.39**
Interaction	44.38	10	0.91
Linear	7.26	1	0.06
Quadratic	195.21	1	6.46**
Cubic	100.16	1	1.88
Quartic	0.46	1	0.01
Error	48.57	140	
Linear	115.39	14	
Quadratic	30.24	14	
Cubic	53.16	14	
Quartic	67.70	14	

*F of 1.83 needed for significance at .05 for df 10,140
**F of 4.60 needed for significance at .05 for df 1,14

Blood Pressure. Tables 17a through 17e provide mean blood pressure values for each group during each time period. Table 18 provides F-ratios and descriptions of significant difference in trends found in blood pressure response between meditators and nonmeditators. Figures 18a and 18b illustrate the difference in trends presented in Table 18. Analysis of variance tables are provided for each significant difference in trends (Tables 19a and 19b).

Analysis of comparisons of trends of blood pressure response of meditators and nonmeditators in the experimental condition showed a pretest difference during the performance period (cubic) and a posttest difference during the adaptation through minute three time period (quadratic). No significant difference in trends was found during pretest or posttest for meditators and nonmeditators in the control condition.

TABLE 17a

MEAN BLOOD PRESSURE RESPONSE* TO THE BICYCLE TASK DURING ADAPTATION THROUGH MINUTE THREE OF PERFORMANCE

	Adaptation	Minute		
		1	2	3
Meditators				
Experimental				
Pretest	106	112	119	121
Posttest	100	107	112	112
Control				
Pretest	102	111	115	121
Posttest	101	107	112	114
Nonmeditators				
Experimental				
Pretest	104	114	117	121
Posttest	106	110	115	120
Control				
Pretest	108	120	122	127
Posttest	107	112	120	123

* indicated in mm Hg

TABLE 17b

MEAN BLOOD PRESSURE RESPONSE* TO THE BICYCLE TASK DURING PERFORMANCE

Interpolated Minutes of Performance	Meditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
1	110	105	107	104
2	112	108	112	108
3	116	109	115	111
4	119	111	117	114
5	122	113	119	115
6	124	115	122	115
7	126	117	122	116
8	127	119	124	118
9	129	122	127	120
10	130	125	128	123
11	132	127	130	124
12	134	130	131	127
13	136	132	132	129
14	139	135	134	131
15	144	136	136	134
16	145	149	139	137
17	149	142	142	140
18	154	145	145	142
19	156	147	147	145
20	159	150	149	148

*indicated in mm Hg

TABLE 17c

MEAN BLOOD PRESSURE RESPONSE* TO THE BICYCLE TASK DURING PERFORMANCE

Interpolated Minutes of Performance	Nonmeditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
1	109	108	115	110
2	113	109	119	114
3	115	112	121	118
4	117	115	123	120
5	118	118	124	121
6	119	119	125	122
7	121	121	128	123
8	123	123	130	125
9	123	125	130	128
10	131	127	131	130
11	133	130	134	132
12	136	132	137	133
13	138	134	139	136
14	140	137	141	139
15	142	140	143	140
16	143	143	146	143
17	146	146	151	150
18	148	149	151	150
19	151	152	153	153
20	153	155	155	157

*indicated in mm Hg

TABLE 17d

MEAN BLOOD PRESSURE RESPONSE* TO THE BICYCLE TASK DURING THE LAST PERFORMANCE BLOOD PRESSURE THROUGH RECOVERY

	Meditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
Last Blood Pressure	159	150	149	148
Recovery Minute 1	152	146	144	137
Recovery Minute 2	138	134	129	127
Recovery Minute 3	124	125	116	122
Recovery Minute 4	116	117	109	111
Recovery Minute 5	112	110	110	107
Recovery Minute 6	108	108	107	103
Recovery Minute 7	105	105	103	103
Recovery Minute 8	105	106	100	101
Recovery Minute 9	104	105	101	101
Recovery Minute 10	103	105	100	101

*indicated in mm Hg

TABLE 17e

MEAN BLOOD PRESSURE RESPONSE* TO THE BICYCLE TASK DURING THE LAST PERFORMANCE BLOOD PRESSURE THROUGH RECOVERY

	Nonmeditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
Last Blood Pressure	153	155	155	157
Recovery Minute 1	146	148	143	143
Recovery Minute 2	133	140	132	128
Recovery Minute 3	121	124	121	122
Recovery Minute 4	116	118	117	117
Recovery Minute 5	110	112	113	113
Recovery Minute 6	109	109	109	109
Recovery Minute 7	107	107	108	107
Recovery Minute 8	106	107	107	107
Recovery Minute 9	104	106	105	107
Recovery Minute 10	104	104	104	106

*indicated in mm Hg

TABLE 18

SIGNIFICANT* COMPARISONS OF TREND OF BLOOD PRESSURE RESPONSE TO THE BICYCLE TASK BETWEEN MEDITATORS AND NONMEDITATORS

	Adaptation/ Minute 3	Interpolated Performance	Last Performance Blood Pressure Recovery
Meditators/ Nonmeditators			
Experimental			
Pretest		cubic F 4.91	
Posttest	quadratic F 11.67		
Control			
Pretest			
Posttest			

*F of 4.60 necessary for significance at .05 for df 1,14

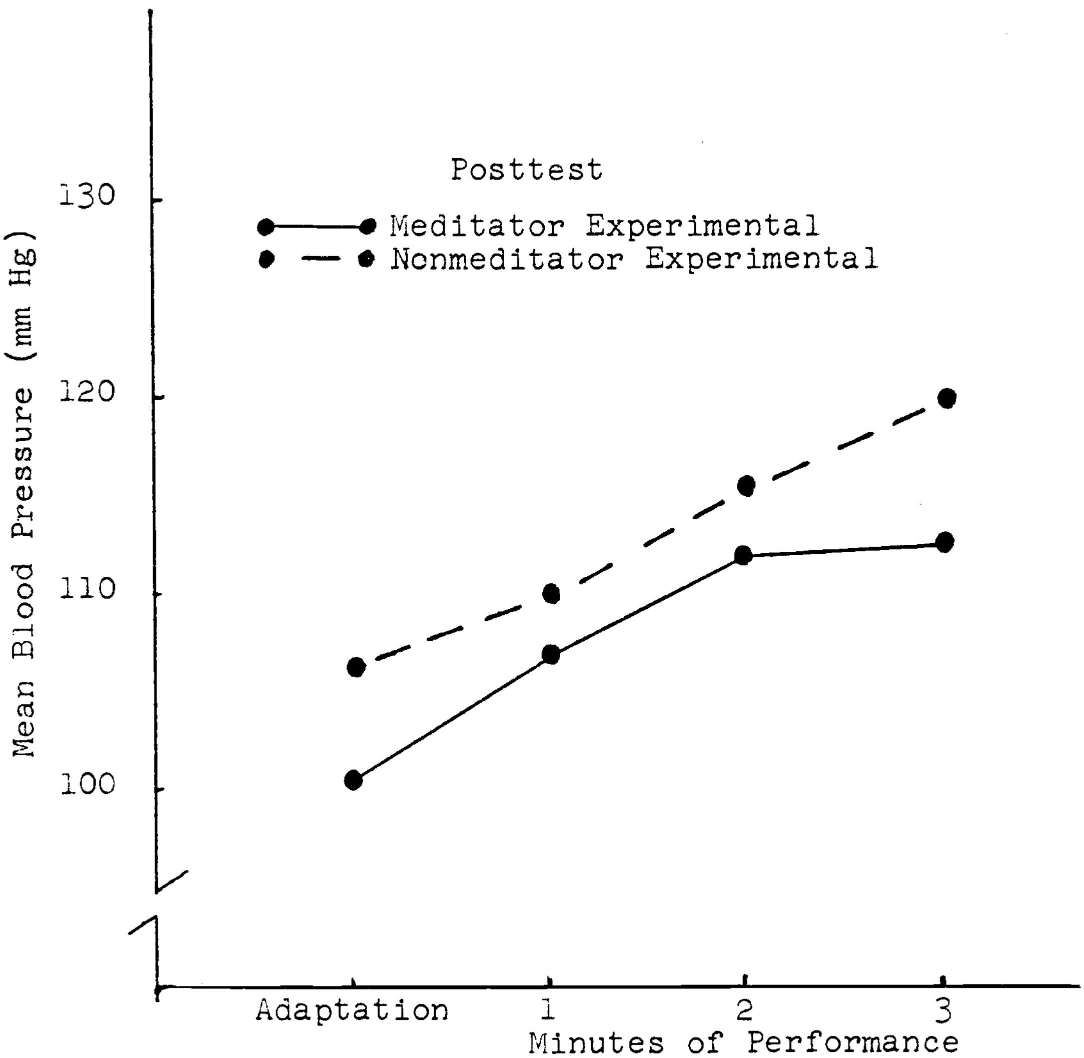

Figure 18a

Bicycle Blood Pressure Response Comparing Meditator and Nonmeditator Experimental Groups During Adaptation and the First Three Minutes of Performance of the Posttest

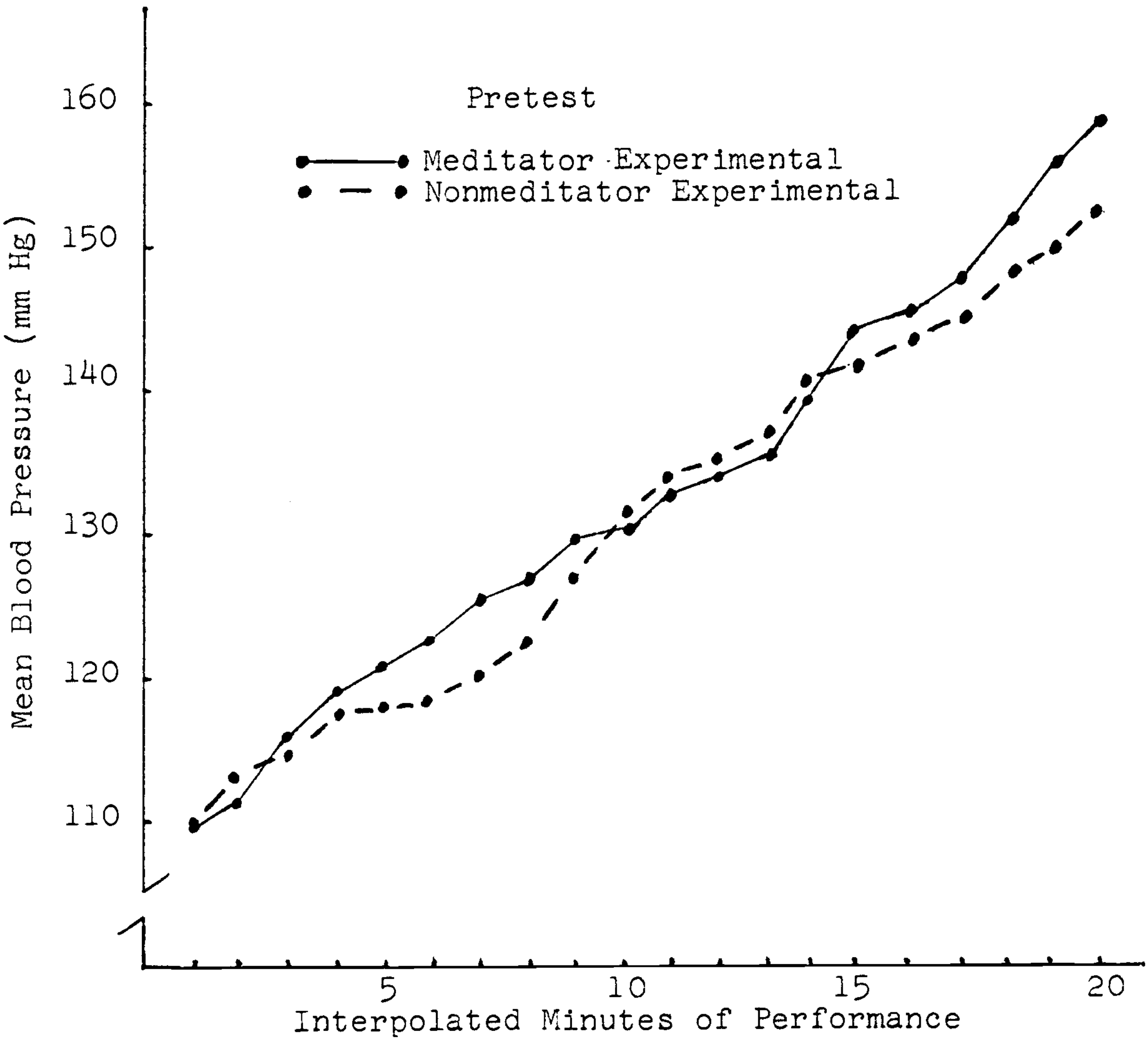

Figure 18b

Bicycle Blood Pressure Response Comparing Meditator and Nonmeditator Experimental Groups During Performance of the Pretest

TABLE 19a

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE BLOOD PRESSURE RESPONSE
COMPARING MEDITATOR AND NONMEDITATOR EXPERIMENTAL GROUPS
DURING ADAPTATION THROUGH MINUTE THREE OF PERFORMANCE
OF THE POSTTEST

Source of Variation	Mean Square	Df	F-Ratio
Total	163.92	63	
Meditator/ Nonmeditator	522.53	15	
	390.06	1	0.73
Error	531.99	14	
Time Period	51.85	48	
	511.27	3	24.01*
Linear	1505.11	1	39.96
Quadratic	20.25	1	4.20
Cubic	8.45	1	0.40
Interaction	20.27	3	0.95
Linear	4.51	1	0.12
Quadratic	56.25	1	11.67**
Cubic	0.05	1	0.01
Error	21.30	42	
Linear	37.67	14	
Quadratic	4.82	14	
Cubic	21.39	14	

*F of 2.85 needed for significance at .05 for df 3,42
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 19b

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE BLOOD PRESSURE RESPONSE
COMPARING MEDITATOR AND NONMEDITATOR EXPERIMENTAL GROUPS
DURING PERFORMANCE OF THE PRETEST

Source of Variation	Mean Square	Df	F-Ratio
Total	435.43	319	
Meditator/ Nonmeditator	4767.96	15	
	306.74	1	0.06
Error	5086.61	14	
Time Period	221.66	304	
	3129.95	19	113.20*
Linear	59232.94	1	210.05**
Quadratic	119.88	1	1.25
Cubic	37.03	1	0.84
Quartic	26.33	1	0.78
Interaction	29.50	19	1.07
Linear	40.24	1	0.14
Quadratic	60.34	1	0.63
Cubic	216.87	1	4.91**
Quartic	66.21	1	1.97
Error	27.65	266	
Linear	281.99	14	
Quadratic	95.81	14	
Cubic	44.13	14	
Quartic	33.59	14	

*F of 1.59 needed for significance at .05 for df 19,266
**F of 4.60 needed for significance at .05 for df 1,14

During the last performance blood pressure through recovery time period, a significant quartic difference in trends was found between experimental and control nonmeditators during the posttest. Figure 19 illustrates the significant difference in trends found. TAble 20 provides the analysis of variance table for the significant comparison. No significant difference was found for the pretest during any of the time periods for the nonmeditators. Meditators showed no significant difference when comparing experimental and control groups in any of the time periods, pretest or posttest.

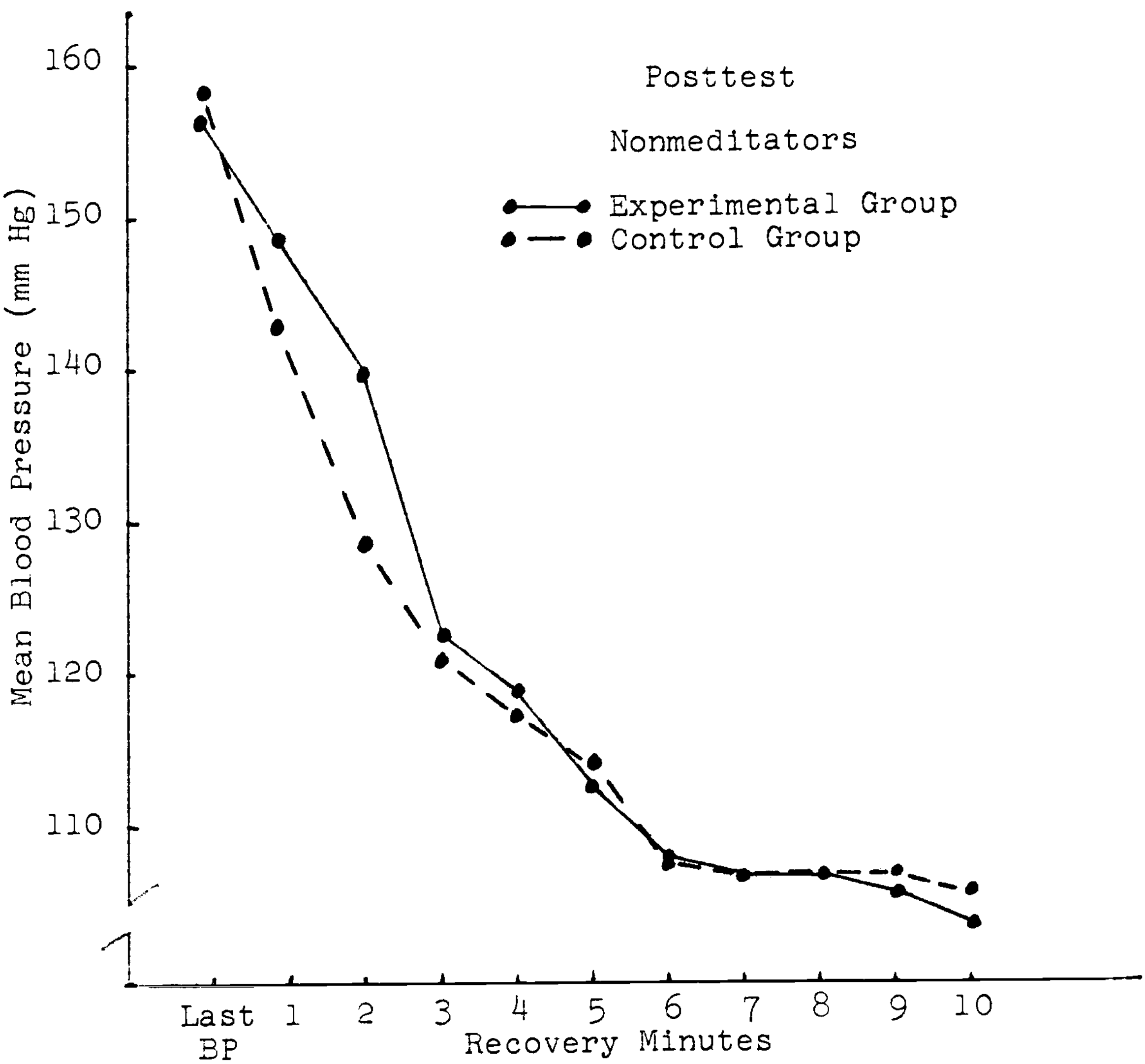

Figure 19

Bicycle Blood Pressure Response Comparing Experimental and Control Groups of Nonmeditators During the Last Performance Blood Pressure Through Recovery of the Posttest

TABLE 20

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE BLOOD PRESSURE RESPONSE
COMPARING EXPERIMENTAL AND CONTROL GROUPS OF NONMEDITATORS
DURING THE LAST PERFORMANCE BLOOD PRESSURE THROUGH RECOVERY
OF THE POSTTEST

Source of Variation	Mean Square	Df	F-Ratio
Total	444.42	175	
Pretest/ Posttest	1389.50	15	
	73.84	1	0.05
Error	1483.48	14	
Time Period	355.83	160	
	4909.72	10	95.52*
Linear	41186.48	1	184.88**
Quadratic	7510.47	1	54.52**
Cubic	193.46	1	5.36**
Quartic	203.08	1	6.99**
Interaction	63.79	10	1.24
Linear	157.20	1	0.71
Quadratic	18.65	1	0.14
Cubic	100.31	1	2.78
Quartic	203.08	1	11.56**
Error	51.40	140	
Linear	222.78	14	
Quadratic	137.76	14	
Cubic	36.09	14	
Quartic	17.57	14	

*F of 1.83 needed for significance at .05 for df 10,140
**F of 4.60 needed for significance at .05 for df 1,14

Table 21 provides F-ratios and descriptions of significant difference in trends of blood pressure response in pretest to posttest comparisons. Figures 20a and 20b illustrate the difference in trends of blood pressure response presented in Table 21. Analysis of variance tables are provided for each significant difference in trends (Table 22a and 22b).

Pretest and posttest comparisons reflected significant difference in trends during adaptation through minute three: experimental nonmeditators showed a quadratic trend difference, control meditators showed a cubic trend difference. No other difference was shown for pretest to posttest comparisons in any time period.

TABLE 21

SIGNIFICANT* COMPARISONS OF TREND
OF BLOOD PRESSURE RESPONSE TO THE BICYCLE TASK
BETWEEN PRETEST AND POSTTEST

	Adaptation/ Minute 3	Interpolated Performance	Last Performance Blood Pressure Recovery
Pretest/ Posttest			
Meditators			
Experimental			
Control			
Nonmeditators			
Experimental	quadratic F 5.48		
Control	cubic F 6.15		

*F of 4.60 necessary for significance at .05 for df 1,14

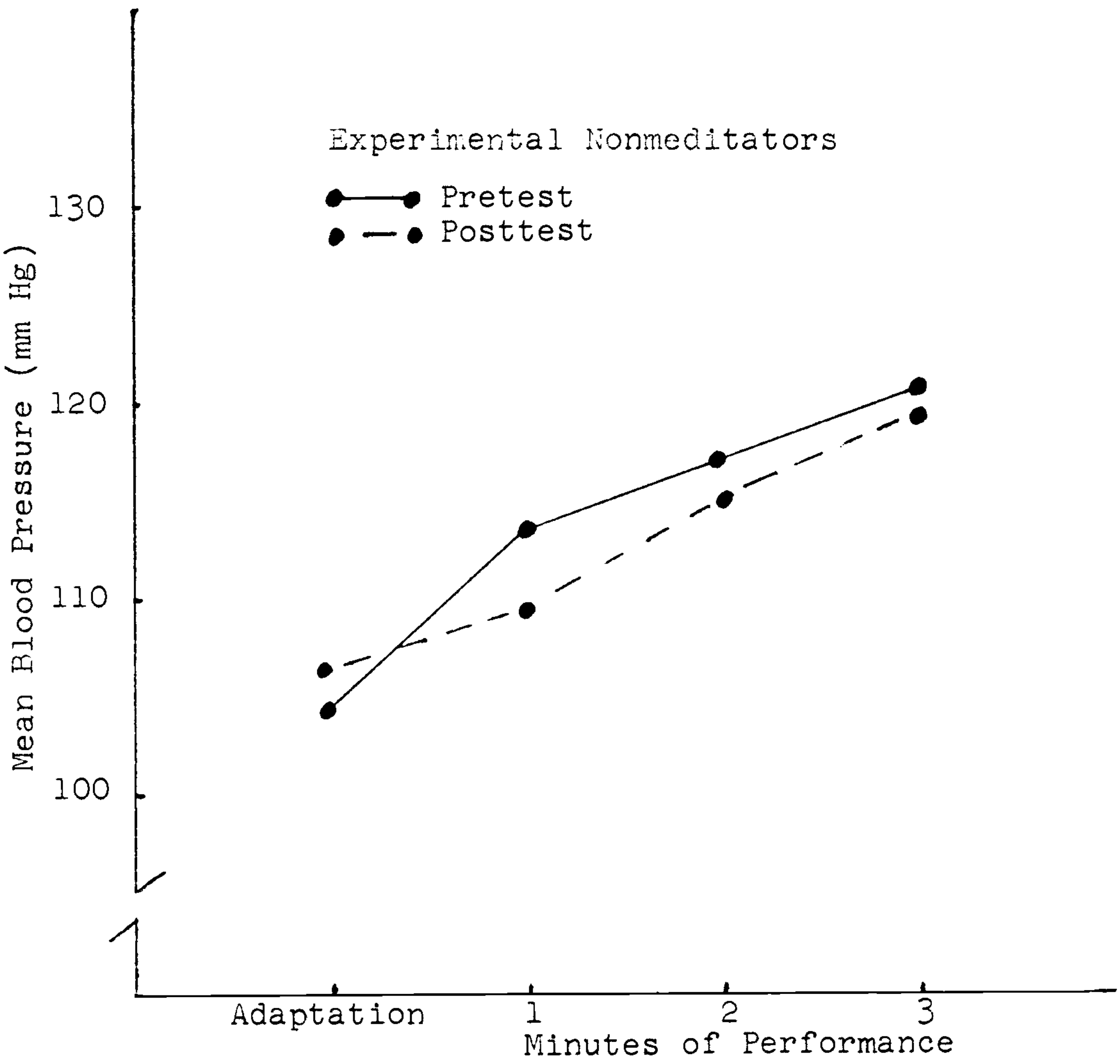

Figure 20a

Bicycle Blood Pressure Response Comparing Pretest and Posttest of Nonmeditators in the Experimental Group During Adaptation and the First Three Minutes of Performance

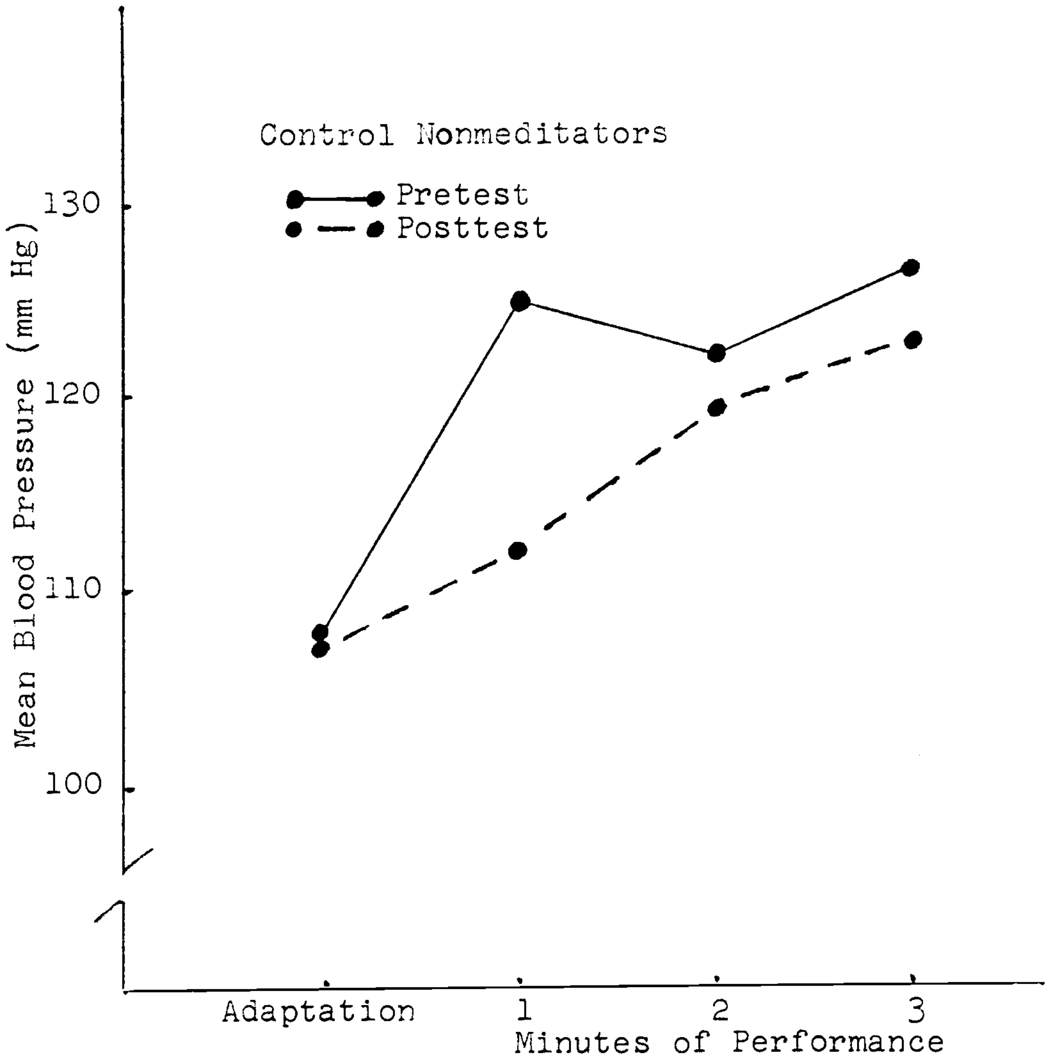

Figure 20b

Bicycle Blood Pressure Response Comparing Pretest and Posttest of Nonmeditators in the Control Group During Adaptation and the First Three Minutes of Performance

TABLE 22a

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE BLOOD PRESSURE RESPONSE
COMPARING PRETEST AND POSTTEST
OF NONMEDITATORS IN THE EXPERIMENTAL GROUP
DURING ADAPTATION THROUGH MINUTE THREE OF PERFORMANCE

Source of Variation	Mean Square	Df	F-Ratio
Total	213.84	63	
Pretest/ Posttest	710.65	15	
	25.00	1	0.03
Error	759.63	14	
Time Period	58.58	48	
	659.63	3	36.74*
Linear	1960.20	1	64.58**
Quadratic	18.06	1	1.88
Cubic	.61	1	0.04
Interaction	26.38	3	1.47
Linear	11.25	1	0.37
Quadratic	52.56	1	5.48**
Cubic	15.31	1	1.10
Error	17.95	42	
Linear	30.35	14	
Quadratic	9.60	14	
Cubic	13.91	14	

*F of 2.85 needed for significance at .05 for df 3,42
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 22b

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE BLOOD PRESSURE RESPONSE
COMPARING PRETEST AND POSTTEST
OF THE NONMEDITATORS IN THE CONTROL GROUP
DURING ADAPTATION THROUGH MINUTE THREE OF PERFORMANCE

Source of Variation	Mean Square	Df	F-Ratio
Total	134.56	63	
Pretest/ Posttest	333.63	15	
	217.56	1	0.64
Error	341.92	14	
Time Period	72.35	48	
	873.90	3	49.83*
Linear	2520.01	1	95.08**
Quadratic	95.06	1	6.7688
Cubic	6.61	1	0.55
Interaction	38.23	3	2.18
Linear	1.51	1	0.06
Quadratic	26.51	1	2.78
Cubic	74.11	1	6.15**
Error	17.54	42	
Linear	26.51	14	
Quadratic	14.06	14	
Cubic	12.05	14	

*F of 2.85 needed for significance at .05 for df 3,42
**F of 4.60 needed for significance at .05 for df 1,14

Frontalis EMG. Frontalis EMG values were analyzed from data gathered using one minute integrated EMG scores measured in microvolts. Tables 23a through 23e provide mean values for frontalis EMG response for each group during each time period. Table 24 provides F-ratios and descriptions of significant difference in trends found in frontalis EMG response between meditators and nonmeditators. Figures 21a through 21d illustrate the difference in trends presented in Table 24. Analysis of variance tables are provided for each significant difference in trends (Tables 25a through 25d).

Comparing meditators and nonmeditators in the experimental condition during performance a significant quadratic difference in trends was found during the posttest. The last performance EMG values through recovery time period reflected a significant difference in trends between the experimental meditators and experimental nonmeditators; a linear difference in trends was shown during the pretest, and a quartic difference in trends during the posttest. Meditators and nonmeditators in the control condition reflected a significant cubic difference in trends during the last performance EMG through recovery of the posttest. No significant difference was found during the pretest between control groups in this time period.

TABLE 23a

MEAN FRONTALIS EMG RESPONSE* TO THE BICYCLE TASK DURING ADAPTATION THROUGH MINUTE THREE OF PERFORMANCE

	Adaptation	Minute		
		1	2	3
Meditators				
Experimental				
Pretest	5.3	5.3	5.1	5.1
Posttest	5.1	6.5	6.6	6.5
Control				
Pretest	4.9	4.4	4.1	4.6
Posttest	3.9	6.1	6.1	6.3
Nonmeditators				
Experimental				
Pretest	4.2	6.8	6.5	7.0
Postest	3.4	5.7	5.4	5.7
Control				
Pretest	4.7	7.0	7.3	6.6
Posttest	4.9	8.3	7.5	7.5

*indicated in integrated one-minute averages measured in microvolts

TABLE 23b

MEAN FRONTALIS EMG RESPONSE* TO THE BICYCLE TASK DURING PERFORMANCE

Interpolated Minutes of Performance	Meditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
1	5.3	6.1	4.2	5.2
2	5.2	6.7	4.3	5.9
3	5.0	6.6	4.2	6.1
4	4.9	6.7	4.2	6.1
5	5.1	6.8	4.4	6.1
6	5.1	6.6	4.5	6.1
7	5.2	6.4	4.5	6.3
8	5.1	6.2	4.6	6.4
9	5.0	6.2	4.6	6.2
10	5.1	6.2	4.5	6.4
11	5.2	6.0	4.4	6.2
12	5.5	6.1	4.5	6.2
13	5.4	6.2	4.5	6.1
14	5.0	6.1	4.3	5.9
15	5.1	6.0	4.2	5.9
16	5.3	6.2	4.1	6.1
17	5.2	6.5	4.1	6.1
18	5.2	6.6	4.0	6.1
19	5.1	6.5	3.9	6.2
20	5.0	6.2	4.0	6.3

*indicated in one-minute integrated averages measured in microvolts

TABLE 23c

MEAN FRONTALIS EMG RESPONSE* TO THE BICYCLE TASK DURING PERFORMANCE

Interpolated Minutes of Performance	Nonmeditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
1	5.3	4.6	6.8	7.8
2	6.3	5.4	7.4	7.3
3	6.6	5.5	6.5	7.4
4	6.4	5.4	6.5	7.4
5	6.6	5.6	6.5	7.4
6	6.9	5.5	6.6	7.3
7	7.1	5.7	6.6	7.2
8	7.0	5.9	6.8	7.2
9	7.0	6.0	6.8	7.2
10	6.8	5.8	6.8	7.1
11	6.7	5.6	7.0	7.1
12	6.7	5.6	7.0	7.1
13	6.7	5.3	7.0	7.1
14	6.7	5.2	6.9	7.1
15	6.7	5.3	6.9	7.2
16	6.7	5.1	6.9	7.0
17	6.7	5.0	7.1	6.6
18	6.7	4.9	7.2	6.2
19	6.5	4.7	7.0	6.1
20	6.3	4.6	6.9	6.1

*indicated in one-minute integrated averages measured in microvolts

TABLE 23d

MEAN FRONTALIS EMG RESPONSE* TO THE BICYCLE TASK DURING THE LAST PERFORMANCE EMG THROUGH RECOVERY

	Meditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
Last Performance EMG	5.0	6.2	4.0	6.3
Recovery Minute 1	4.1	5.5	3.7	5.6
Recovery Minute 2	4.6	4.3	3.1	3.7
Recovery Minute 3	4.5	4.1	2.7	3.4
Recovery Minute 4	4.6	4.7	2.7	3.4
Recovery Minute 5	4.8	5.3	2.9	3.0
Recovery Minute 6	4.8	5.1	3.0	3.0
Recovery Minute 7	4.8	5.5	2.9	3.4
Recovery Minute 8	5.1	5.3	3.2	3.2
Recovery Minute 9	5.3	4.4	3.3	3.2
Recovery Minute 10	5.1	4.9	3.7	3.4

*indicated in one-minute intergrated averages measured in microvolts

TABLE 23e

MEAN FRONTALIS EMG RESPONSE* TO THE BICYCLE TASK DURING THE LAST PERFORMANCE EMG THROUGH RECOVERY

	Nonmeditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
Last Performance EMG	6.3	4.6	6.9	6.1
Recovery Minute 1	5.7	4.6	7.0	5.6
Recovery Minute 2	4.2	3.6	4.9	6.6
Recovery Minute 3	4.3	3.1	5.1	5.6
Recovery Minute 4	4.2	3.0	5.3	5.3
Recovery Minute 5	4.2	3.1	4.7	4.6
Recovery Minute 6	4.2	3.1	5.2	4.3
Recovery Minute 7	3.9	3.3	5.4	4.2
Recovery Minute 8	4.1	3.3	5.9	4.5
Recovery Minute 9	3.9	3.3	5.9	4.3
Recovery Minute 10	4.1	3.3	6.0	4.6

*indicated in one-minute integrated averages measured in microvolts

TABLE 24

SIGNIFICANT* COMPARISONS OF TREND
OF FRONTALIS EMG RESPONSE TO THE BICYCLE TASK
BETWEEN MEDITATORS AND NONMEDITATORS

	Adaptation/ Minute 3	Interpolated Performance	Last Performance EMG/ Recovery
Meditators/ Nonmeditators			
Experimental			
Pretest			linear F 4.62
Posttest		quadratic F 4.75	quartic F 6.19
Control			
Pretest			
Posttest			cubic F 6.84

*F of 4.60 needed for significance at .05 for df 1,14

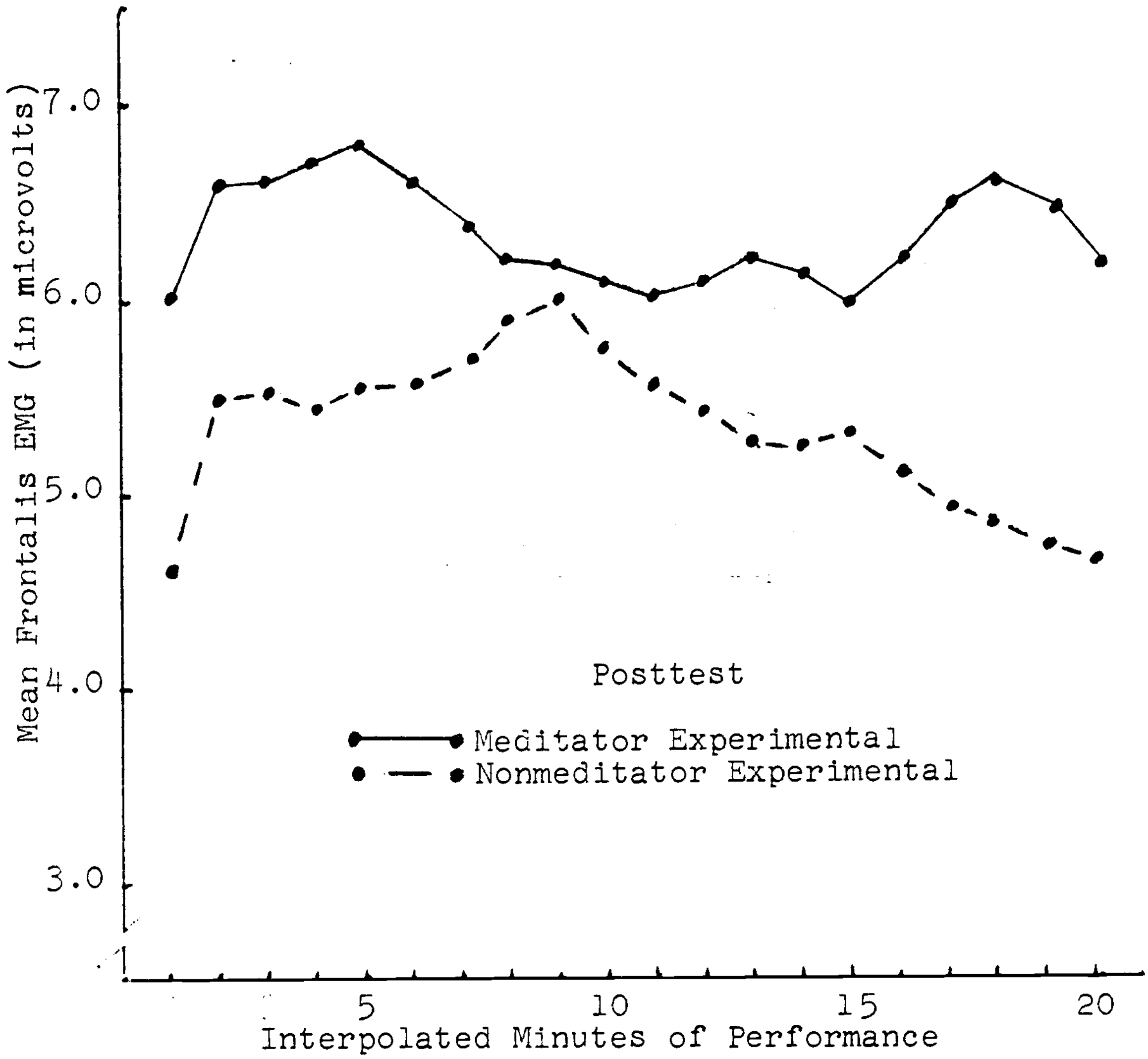

Figure 21a

Bicycle Frontalis EMG Response Comparing Meditator and Nonmeditator Experimental Groups During Performance of the Posttest

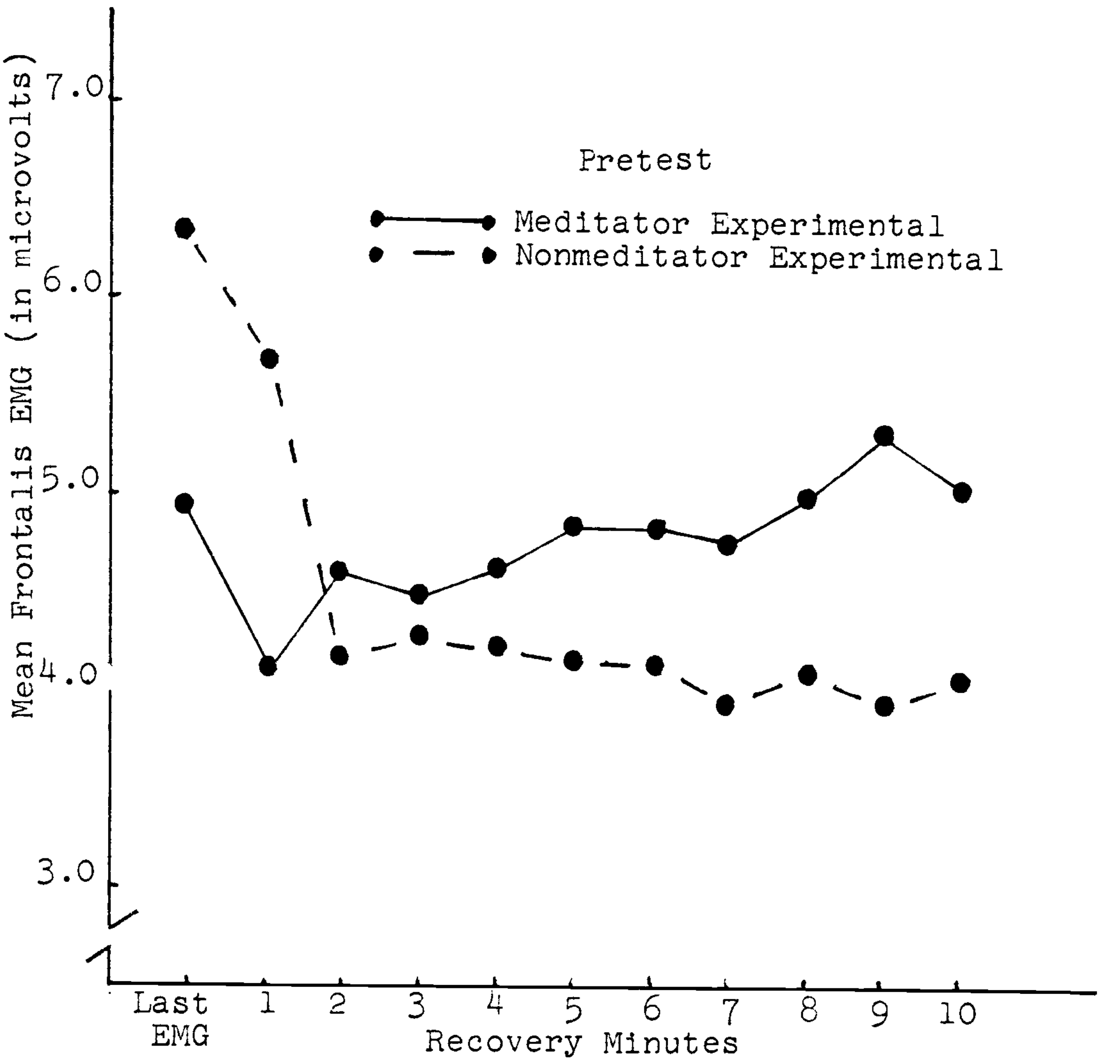

Figure 21b

Bicycle Frontalis EMG Response Comparing Meditators and Nonmeditators in the Experimental Group During the Last Performance EMG Through Recovery of the Pretest

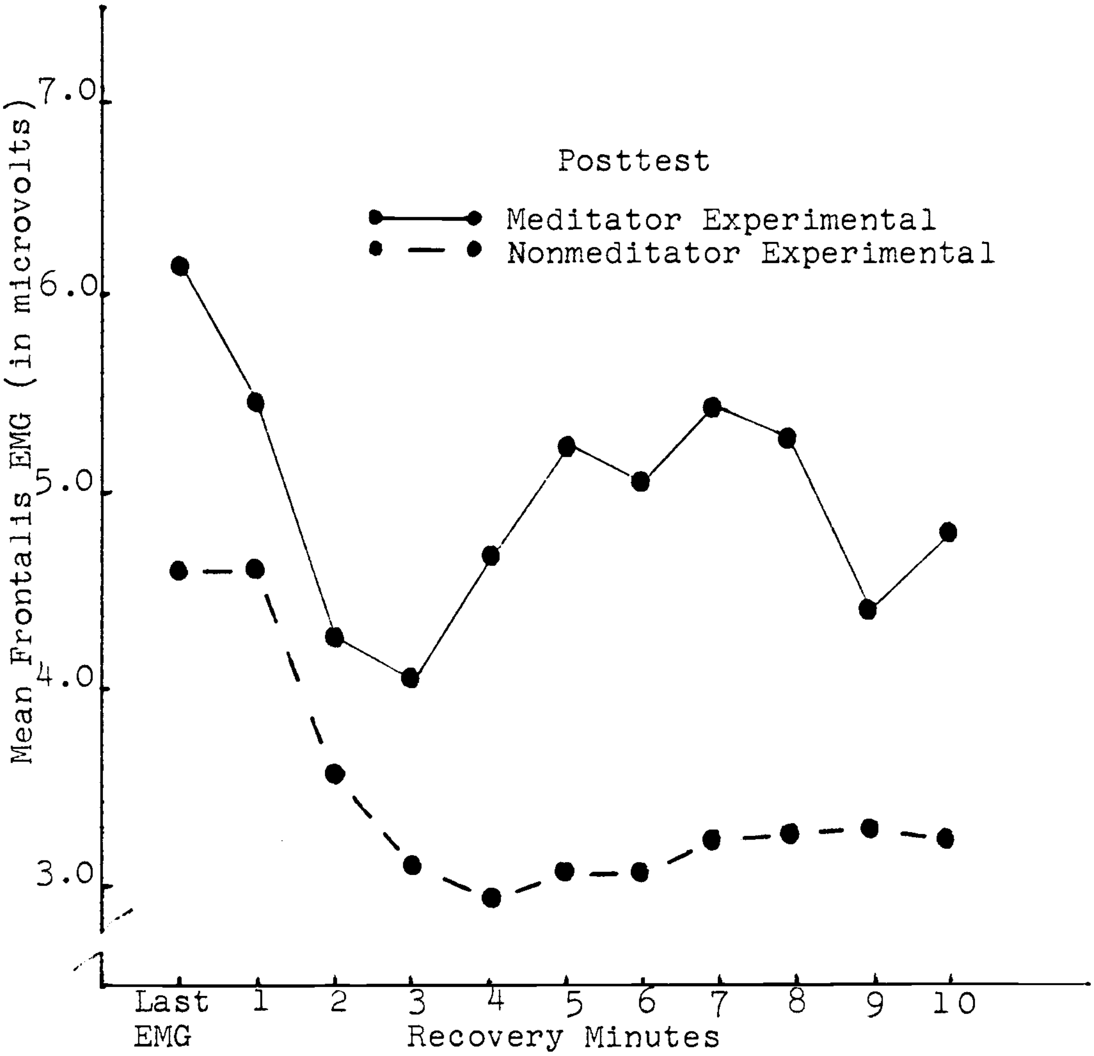

Figure 21c

Bicycle Frontalis EMG Response Comparing Meditators and Nonmeditators in the Experimental Group During the Last Performance EMG Through Recovery of the Posttest

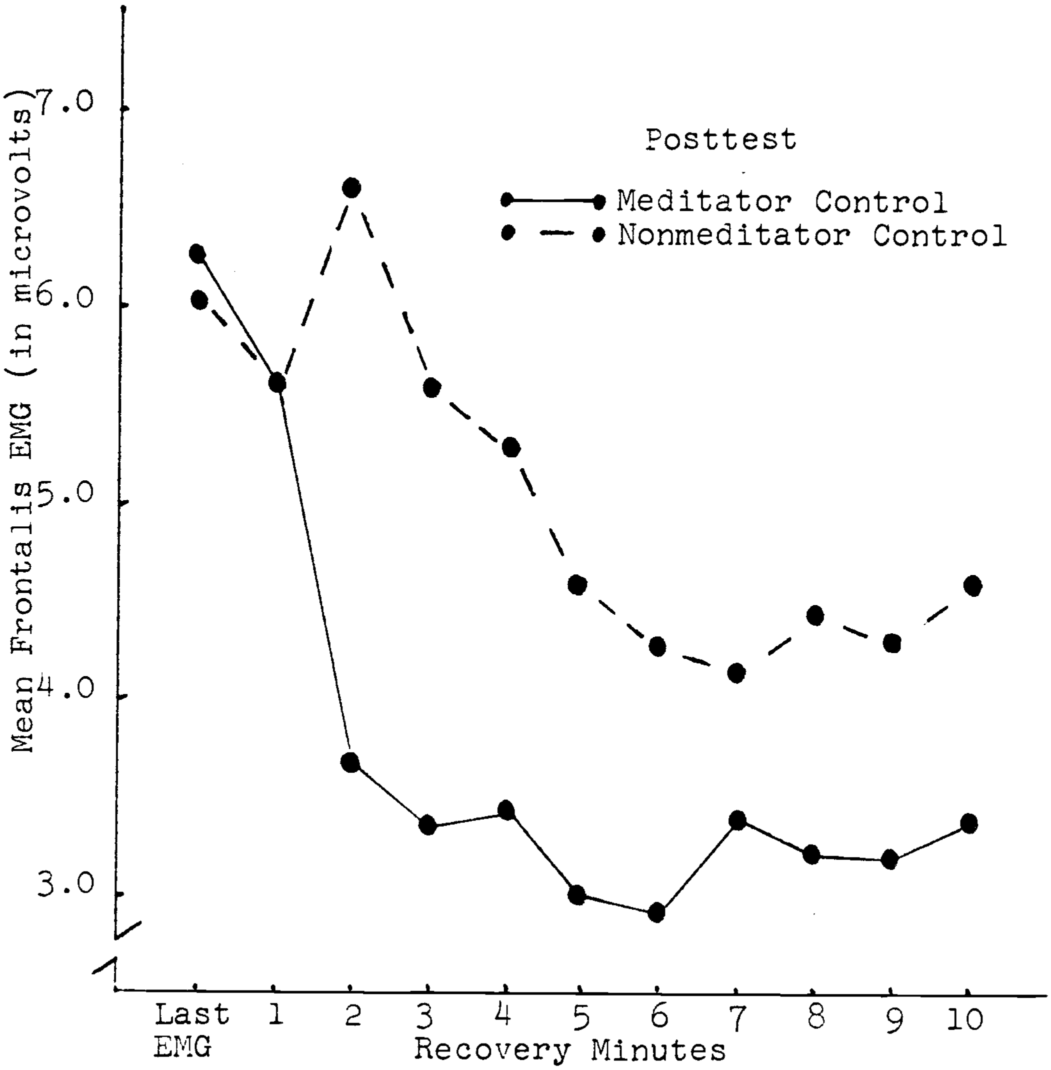

Figure 21d

Bicycle Frontalis EMG Response Comparing Meditators and Nonmeditators in the Control Group During the Last Performance EMG Through Recovery of the Posttest

TABLE 25a

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE FRONTALIS EMG RESPONSE
COMPARING MEDITATOR AND NONMEDITATOR EXPERIMENTAL GROUPS
DURING THE LAST PERFORMANCE EMG THROUGH RECOVERY
OF THE PRETEST

Source of Variation	Mean Square	Df	F-Ratio
Total	5.28	175	
Meditator/ Nonmeditator	42.79	15	
	4.75	1	0.10
Error	45.50	14	
Time Period	1.76	160	
	2.22	10	1.38
Linear	5.12	1	0.93
Quadratic	10.49	1	1.94
Cubic	4.62	1	6.64*
Quartic	0.98	1	0.53
Interaction	3.55	10	2.22
Linear	25.56	1	4.62*
Quadratic	4.58	1	0.85
Cubic	0.47	1	0.68
Quartic	0.06	1	0.03
Error	1.80	140	
Linear	5.53	14	
Quadratic	5.41	14	
Cubic	0.79	14	
Quartic	1.84	14	

*F of 4.60 needed for significance at .05 for df 1,14

TABLE 25b

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE FRONTALIS EMG RESPONSE
COMPARING MEDITATOR AND NONMEDITATOR EXPERIMENTAL GROUPS
DURING THE LAST PERFORMANCE EMG THROUGH RECOVERY
OF THE POSTTEST

Source of Variation	Mean Square	Df	F-Ratio
Total	3.59	175	
Meditator/ Nonmeditator	25.13	15	
	104.01	1	5.33*
Error	19.50	14	
Time Period	1.57	160	
	4.65	10	3.38**
Linear	11.52	1	1.73
Quadratic	12.63	1	3.89
Cubic	14.12	1	13.99*
Quartic	0.37	1	0.72
Interaction	1.15	10	0.84
Linear	2.14	1	0.32
Quadratic	1.41	1	0.42
Cubic	3.30	1	3.27
Quartic	3.21	1	6.19*
Error	1.38	140	
Linear	6.65	14	
Quadratic	3.32	14	
Cubic	1.01	14	
Quartic	0.52	14	

*F of 4.60 needed for significance at .05 for df 1,14
**F of 1.83 needed for significance at .05 for df 10,140

TABLE 25c

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE FRONTALIS EMG RESPONSE
COMPARING MEDITATOR AND NONMEDITATOR CONTROL GROUPS
DURING THE LAST PERFORMANCE EMG THROUGH RECOVERY
OF THE POSTTEST

Source of Variation	Mean Square	Df	F-Ratio
Total	5.70	175	
Meditator/ Nonmeditator	37.52	15	
	71.02	1	2.02
Error	35.13	14	
Time Period	2.72	160	
	11.90	10	5.88*
Linear	86.73	1	9.00**
Quadratic	30.36	1	5.94**
Cubic	0.00	1	0.01
Quartic	0.38	1	0.92
Interaction	3.26	10	1.61
Linear	0.25	1	0.03
Quadratic	9.19	1	1.80
Cubic	12.39	1	6.84**
Quartic	0.59	1	1.43
Error	2.02	140	
Linear	9.63	14	
Quadratic	5.11	14	
Cubic	1.81	14	
Quartic	0.42	14	

*F of 1.83 needed for significance at .05 for df 10,140
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 25d

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE FRONTALIS EMG RESPONSE
COMPARING MEDITATOR AND NONMEDITATOR EXPERIMENTAL GROUPS
DURING PERFORMANCE OF THE POSTTEST

Source of Variation	Mean Square	Df	R-Ratio
Total	3.31	319	
Meditator/ Nonmeditator	56.71	15	
	81.76	1	1.49
Error	54.92	14	
Time Period	0.68	304	
	0.98	19	1.52
Linear	5.67	1	0.87
Quadratic	3.77	1	1.59
Cubic	3.98	1	5.46*
Quartic	2.99	1	4.15
Interaction	0.88	19	1.37
Linear	1.02	1	0.16
Quadratic	11.30	1	4.75*
Cubic	0.00	1	0.01
Quartic	1.73	1	2.40
Error	0.64	266	
Linear	6.50	14	
Quadratic	2.38	14	
Cubic	0.73	14	
Quartic	0.72	14	

*F of 4.60 needed for significance at .05 for df 1,14

Comparing experimental and control groups, a significant difference in trends of frontalis EMG response was found in analysis. During the posttest nonmeditators in the experimental and control groups showed a significant cubic difference in trends during the last performance EMG through recovery time period. Figure 22 illustrates the significant difference in trends found. Table 26 provides the analysis of variance table for the significant comparison.

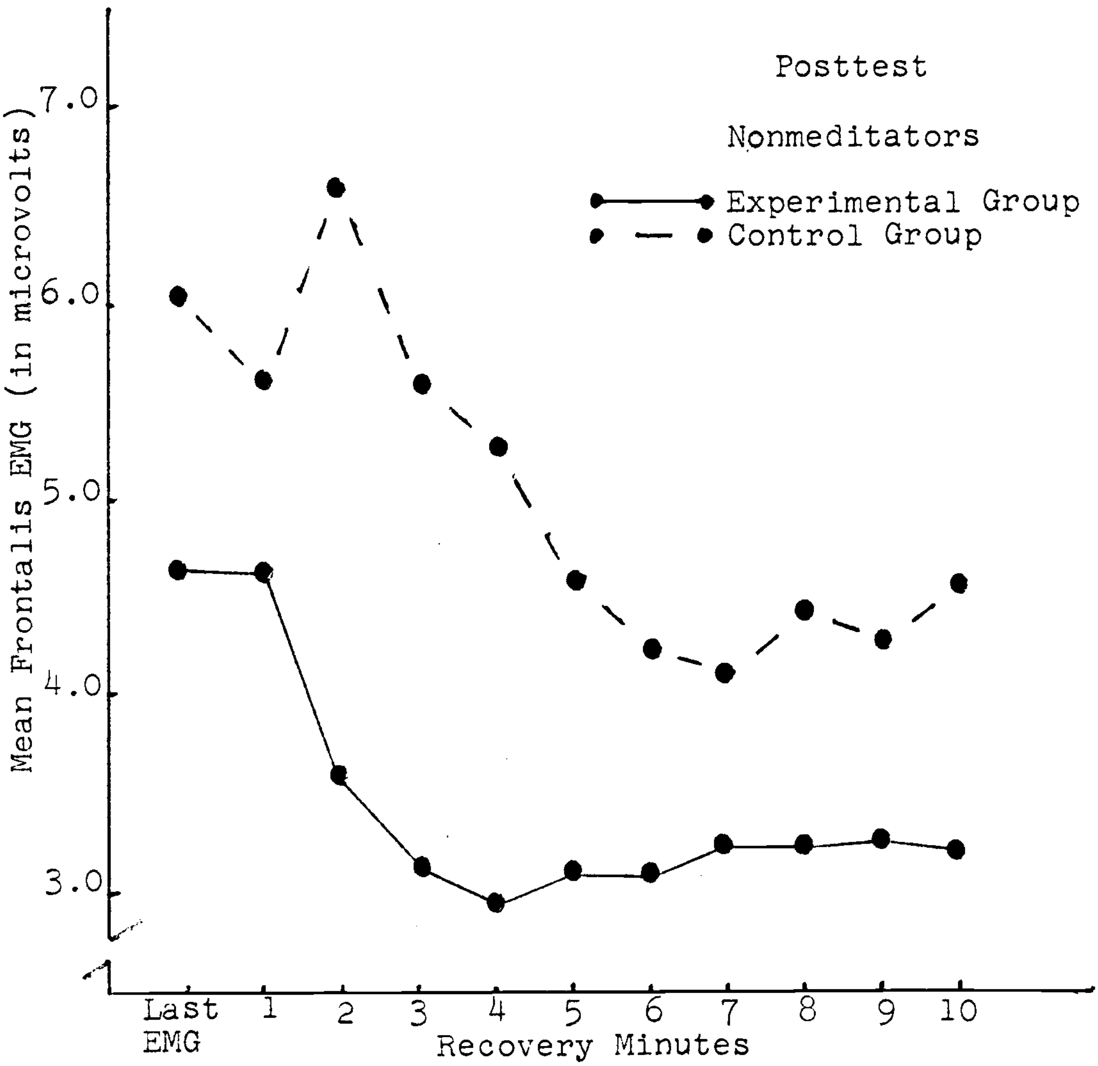

Figure 22

Bicycle Frontalis EMG Response Comparing Experimental and Control Groups of Nonmeditators During the Last Performance EMG Through Recovery of the Posttest

TABLE 26

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE FRONTALIS EMG RESPONSE
COMPARING EXPERIMENTAL AND CONTROL GROUPS OF NONMEDITATORS
DURING THE LAST PERFORMANCE EMG THROUGH RECOVERY
OF THE PRETEST

Source of Variation	Mean	Df	F-Ratio
Total	4.09	175	
Experimental/ Control	32.65	15	
	109.31	1	4.02
Error	27.18	14	
Time Period	1.41	160	
	6.32	10	6.21*
Linear	46.70	1	9.92**
Quadratic	13.03	1	5.52**
Cubic	0.66	1	0.54
Quartic	1.65	1	4.54
Interaction	1.98	10	1.94
Linear	3.91	1	0.83
Quadratic	1.28	1	0.54
Cubic	7.58	1	6.19**
Quartic	0.01	1	0.03
Error	1.01	140	
Linear	4.70	14	
Quadratic	2.36	14	
Cubic	1.23	14	
Quartic	0.36		

*F of 1.83 needed for significance at .05 for df 10,140
**F of 4.60 needed for significance at .05 for df 1,14

Table 27 provides F-ratios and descriptions of significant difference in trends of frontalis EMG response in pretest to posttest comparisons. Figures 23a through 23c illustrate the difference in trends of frontalis EMG response presented in Table 27. Analysis of variance tables are provided for each significant difference in trends (Tables 28a through 28c).

Pretest to posttest difference in trends of frontalis EMG response was reflected in all groups except control nonmeditators. Experimental meditators showed a quartic difference in trends during the performance period. Experimental nonmeditators showed a quartic difference in trends during the last performance EMG through recovery. Control meditators reflected a quadratic trend difference in the adaptation through minute three time period.

TABLE 27

SIGNIFICANT* COMPARISONS OF TRENDS OF FRONTALIS EMG RESPONSE TO THE BICYCLE TASK BETWEEN PRETEST AND POSTTEST

	Adaptation Minute 3	Interpolated Performance	Last Performance EMG/ Recovery
Pretest/ Posttest			
Meditators			
Experimental		quartic F 4.63	
Control	quadratic F 4.61		
Nonmeditators			
Experimental			quartic F 6.89
Control			

*F of 4.60 needed for significance at .05 for df 1,14

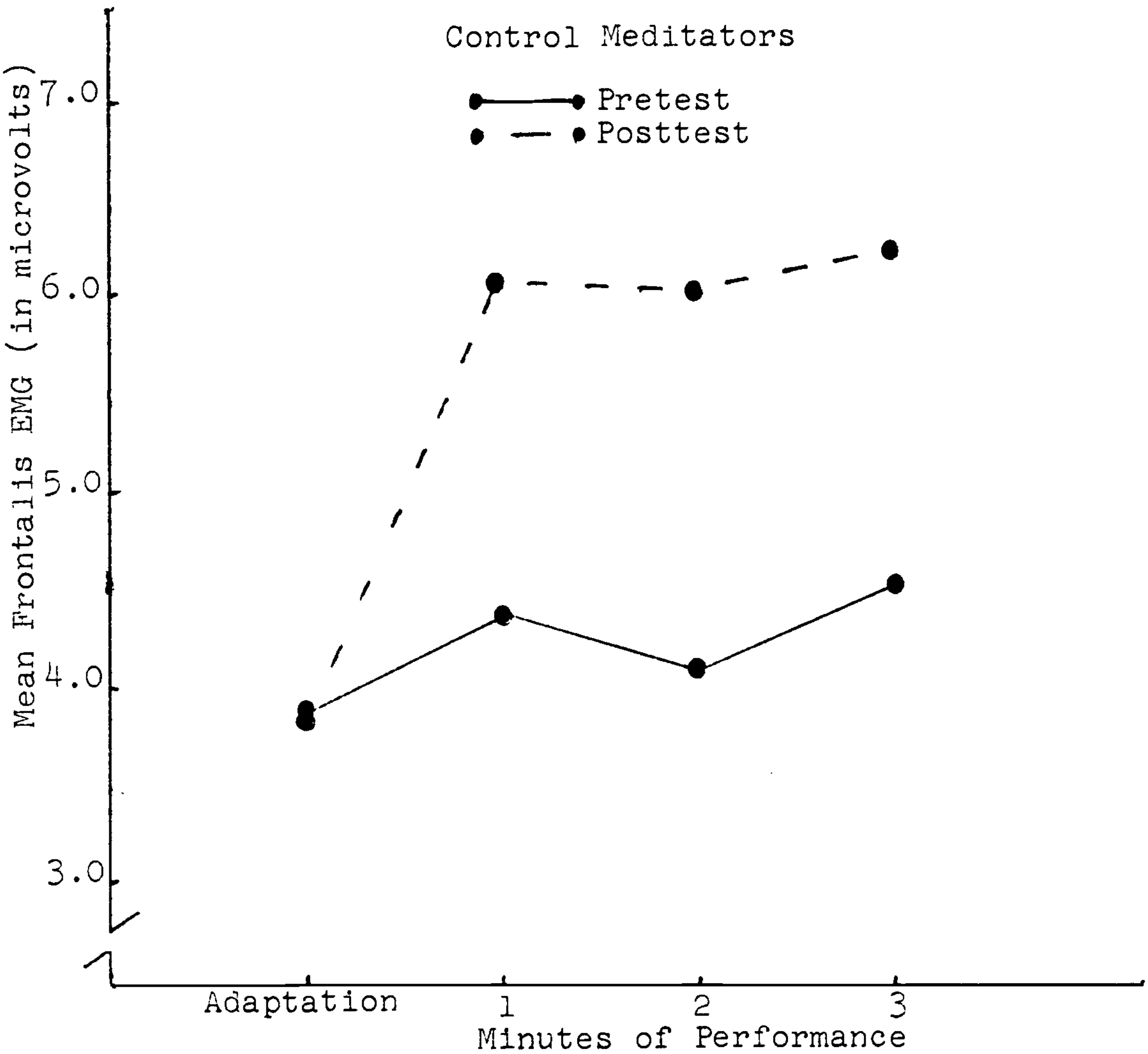

Figure 23a

Bicycle Frontalis EMG Response Comparing Pretest and Posttest of Meditators in the Control Group During Adaptation and the First Three Minutes of Performance

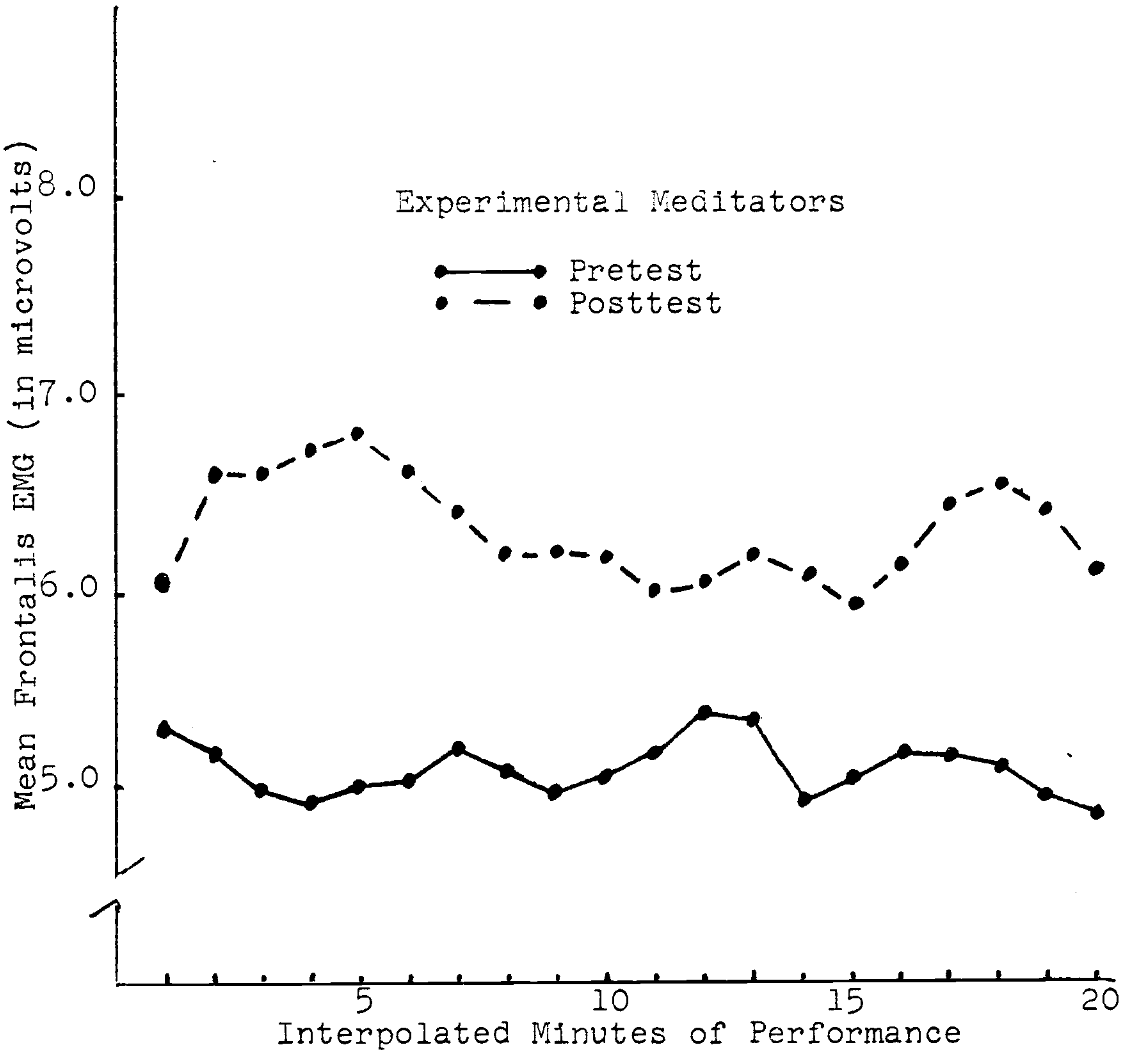

Figure 23b

Bicycle Frontalis EMG Response Comparing Pretest and Posttest of Meditators in the Experimental Group During Performance

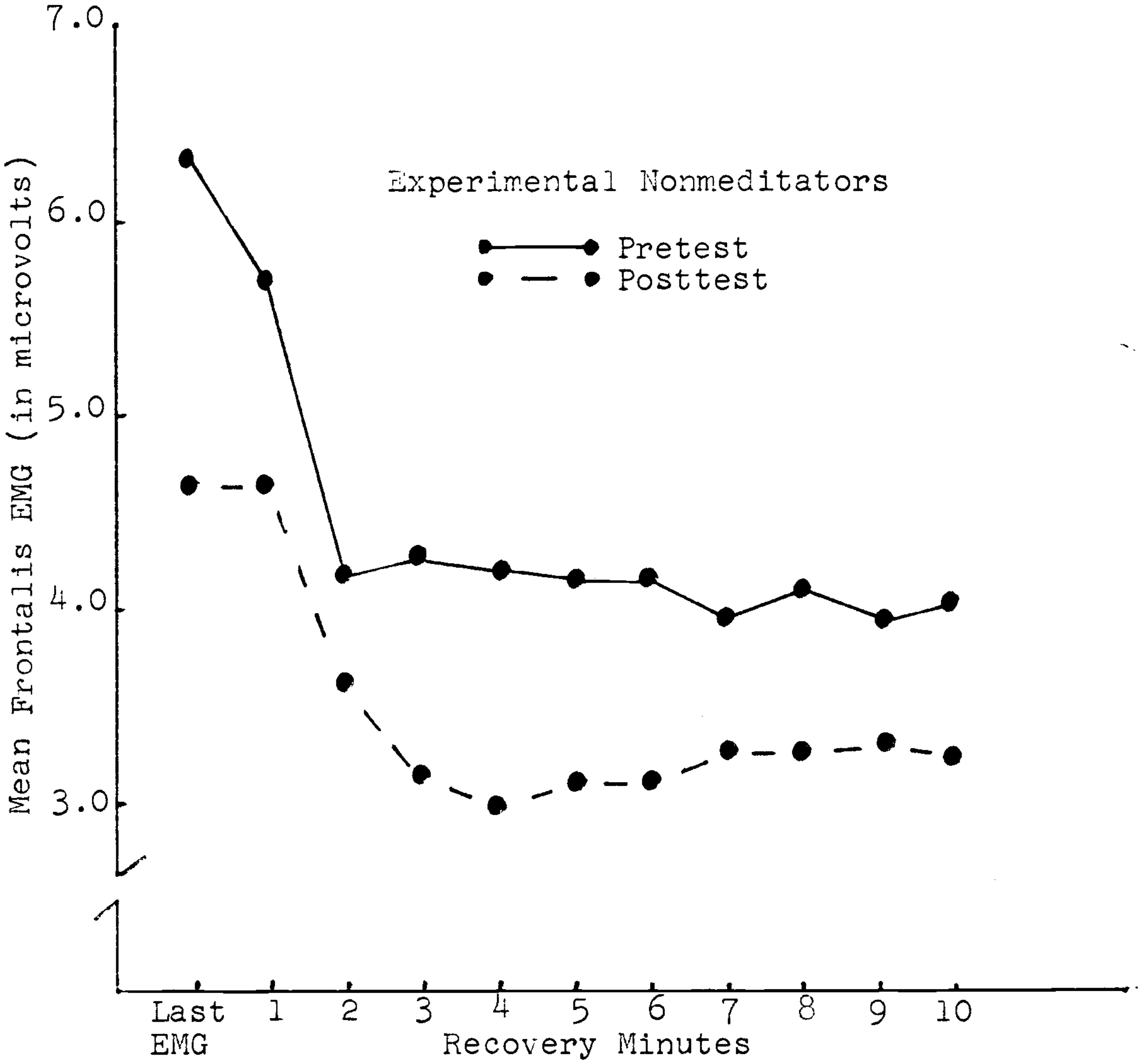

Figure 23c

Bicycle Frontalis EMG Response Comparing Pretest and Posttest of Nonmeditators in the Experimental Group During the Last Performance EMG Through Recovery

TABLE 28a

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE FRONTALIS EMG RESPONSE
COMPARING PRETEST AND POSTTEST
OF MEDITATORS IN THE CONTROL GROUP
DURING ADAPTATION THROUGH MINUTE THREE

Source of Variation	Mean Square	Df	F-Ratio
Total	4.05	63	
Pretest/ Posttest	12.33	15	
	28.36	1	2.54
Error	11.18	14	
Time Period	1.47	48	
	7.69	3	8.64*
Linear	15.49	1	10.87**
Quadratic	4.62	1	5.46**
Cubic	2.97	1	7.45**
Interaction	3.33	3	3.74*
Linear	5.89	1	4.13
Quadratic	3.90	1	4.61**
Cubic	0.19	1	0.48
Error	0.89	42	
Linear	1.43	14	
Quadratic	0.85	14	
Cubic	0.40	14	

*F of 2.85 needed for significance at .05 for df 3,42
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 28b

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE FRONTALIS EMG RESPONSE
COMPARING PRETEST AND POSTTEST
OF MEDITATORS IN THE EXPERIMENTAL GROUP
DURING PERFORMANCE

Source of Variation	Mean Square	Df	F-Ratio
Total	3.78	319	
Pretest/ Posttest	67.29	15	
	115.38	1	1.81
Error	63.86	14	
Time Period	0.65	304	
	0.26	19	0.37
Linear	0.38	1	0.06
Quadratic	0.31	1	0.12
Cubic	0.05	1	0.06
Quartic	1.63	1	2.42
Interaction	0.45	19	0.66
Linear	0.56	1	0.08
Quadratic	0.75	1	0.28
Cubic	2.96	1	3.32
Quartic	3.13	1	4.63*
Error	0.69	266	
Linear	6.70	14	
Quadratic	2.64	14	
Cubic	0.89	14	
Quartic	0.67	14	

*F of 4.60 needed for significance at .05 for df 1,14

TABLE 28c

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE FRONTALIS EMG RESPONSE
COMPARING PRETEST AND POSTTEST
OF NONMEDITATORS IN THE EXPERIMENTAL GROUP
DURING THE LAST EMG THROUGH RECOVERY

Source of Variation	Mean Square	Df	F-Ratio
Total	3.30	175	
Pretest/ Posttest	28.04	15	
	42.02	1	1.55
Error	27.04	14	
Time Period	0.99	160	
	7.29	10	12.68*
Linear	37.06	1	14.93**
Quadratic	25.69	1	18.54**
Cubic	5.71	1	8.12**
Quartic	0.01	1	0.01
Interaction	0.42	10	0.73
Linear	1.51	1	0.61
Quadratic	0.10	1	0.07
Cubic	0.20	1	0.28
Quartic	1.47	1	6.89**
Error	0.58	140	
Linear	2.48	14	
Quadratic	1.38	14	
Cubic	0.70	14	
Quartic	0.21	14	

*F of 1.83 needed for significance at .05 for df 10,140
**F of 4.60 needed for significance at .05 for df 1,14

Rate-Pressure Product. Tables 29a through 29e give means of RPP response between groups by time periods. Figure 24 illustrates the significant difference found in analysis of trends of group mean comparisons of RPP. An analysis of variance table is presented in Table 30 for the significant difference in trends of RPP found.

During the ime period adaptation through minute three, control nonmeditators showed a significant quadratic difference in trend of RPP pretest to posttest. No other significant difference in trends was found in selected time periods between groups for RPP.

TABLE 29a

MEAN RATE-PRESSURE PRODUCT RESPONSE* TO THE BICYCLE TASK DURING ADAPTATION THROUGH MINUTE THREE OF PERFORMANCE

	Adaptation	Minute		
		1	2	3
Meditators				
Experimental				
Pretest	72.0	107.3	113.0	110.5
Posttest	64.6	98.3	104.5	101.9
Control				
Pretest	63.0	104.5	108.5	112.1
Posttest	67.9	97.6	105.1	109.4
Nonmeditators				
Experimental				
Pretest	76.8	116.9	117.8	124.6
Posttest	72.1	105.9	109.3	114.8
Control				
Pretest	74.0	119.3	122.1	122.3
Posttest	74.3	109.0	115.1	121.0

*computed by multiplying heart rate times blood pressure and dividing by 100

TABLE 29b

MEAN RATE-PRESSURE PRODUCT RESPONSE* TO THE BICYCLE TASK DURING PERFORMANCE

Interpolated Minutes of Performance	Meditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
1	93.6	85.9	86.6	84.5
2	104.3	96.1	103.0	96.2
3	107.1	97.7	106.5	102.5
4	111.1	102.5	109.2	107.2
5	118.5	109.1	111.4	110.0
6	121.1	112.7	115.4	113.7
7	127.1	118.4	121.5	117.5
8	134.1	126.3	128.5	121.3
9	141.4	131.2	135.4	126.8
10	145.8	135.6	138.9	132.5
11	152.1	143.3	146.6	139.4
12	160.5	153.4	153.8	148.0
13	169.0	162.0	160.9	156.5
14	177.9	171.4	167.9	165.0
15	188.1	178.2	176.7	174.8
16	197.8	187.9	186.5	184.1
17	210.3	199.7	197.6	194.4
18	223.4	210.6	209.1	205.3
19	233.8	219.4	219.1	217.7
20	245.1	232.0	230.3	230.0

*computed by multiplying heart rate times blood pressure and dividing by 100

TABLE 29c

MEAN RATE-PRESSURE PRODUCT RESPONSE* TO THE BICYCLE TASK DURING PERFORMANCE

Interpolated Minutes of Performance	Nonmeditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
1	98.0	90.9	97.2	92.3
2	112.7	102.7	113.0	104.9
3	115.9	106.3	119.3	111.7
4	119.5	109.9	120.4	116.4
5	122.3	112.2	123.7	120.0
6	123.5	115.6	126.9	122.9
7	126.2	119.7	132.2	125.7
8	132.8	125.7	135.6	129.3
9	142.9	132.9	137.4	135.9
10	151.3	138.6	144.6	142.4
11	157.6	144.7	156.1	148.4
12	163.2	153.1	164.7	155.3
13	171.8	161.2	171.4	163.5
14	179.8	170.5	179.4	.72.7
15	187.2	181.4	188.1	180.4
16	195.4	193.9	200.0	189.2
17	205.0	201.4	209.0	201.7
18	214.7	210.8	218.7	213.3
19	224.3	223.8	229.4	226.9
20	234.8	238.9	242.1	241.8

*computed by multiplying heart rate times blood pressure and dividing by 100

TABLE 29d

MEAN RATE-PRESSURE PRODUCT RESPONSE* TO THE BICYCLE TASK DURING THE LAST PERFORMANCE RPP THROUGH RECOVERY

	Meditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
Last Performance RPP	245.1	232.0	230.3	230.0
Recovery Minute 1	182.4	171.1	164.4	154.4
Recovery Minute 2	136.1	.27.5	114.9	118.3
Recovery Minute 3	111.8	108.8	90.6	97.6
Recovery Minute 4	102.4	104.3	82.8	93.3
Recovery Minute 5	98.1	95.5	84.4	82.3
Recovery Minute 6	88.9	92.1	79.0	80.0
Recovery Minute 7	82.3	84.8	78.4	80.8
Recovery Minute 8	84.5	85.6	73.6	77.4
Recovery Minute 9	82.5	84.6	73.8	76.9
Recovery Minute 10	83.0	84.8	77.6	79.1

*computed by multiplying heart rate times blood pressure and dividing by 100

TABLE 29e

MEAN RATE-PRESSURE PRODUCT RESPONSE* TO THE BICYCLE TASK DURING THE LAST PERFORMANCE RPP THROUGH RECOVERY

	Nonmeditator			
	Experimental		Control	
	Pretest	Posttest	Pretest	Posttest
Last Performance RPP	234.8	238.9	242.1	241.8
Recovery Minute 1	171.3	172.0	158.8	160.1
Recovery Minute 2	120.8	116.5	124.1	114.1
Recovery Minute 3	108.0	96.8	105.6	106.6
Recovery Minute 4	101.5	100.8	98.3	95.8
Recovery Minute 5	97.8	92.3	94.9	91.1
Recovery Minute 6	91.8	89.8	90.0	86.8
Recovery Minute 7	90.3	88.4	87.1	84.9
Recovery Minute 8	91.6	86.1	83.4	83.9
Recovery Minute 9	88.4	83.5	86.3	81.6
Recovery Minute 10	84.0	82.5	85.4	83.8

*computed by multiplying heart rate times blood pressure and dividing by 100

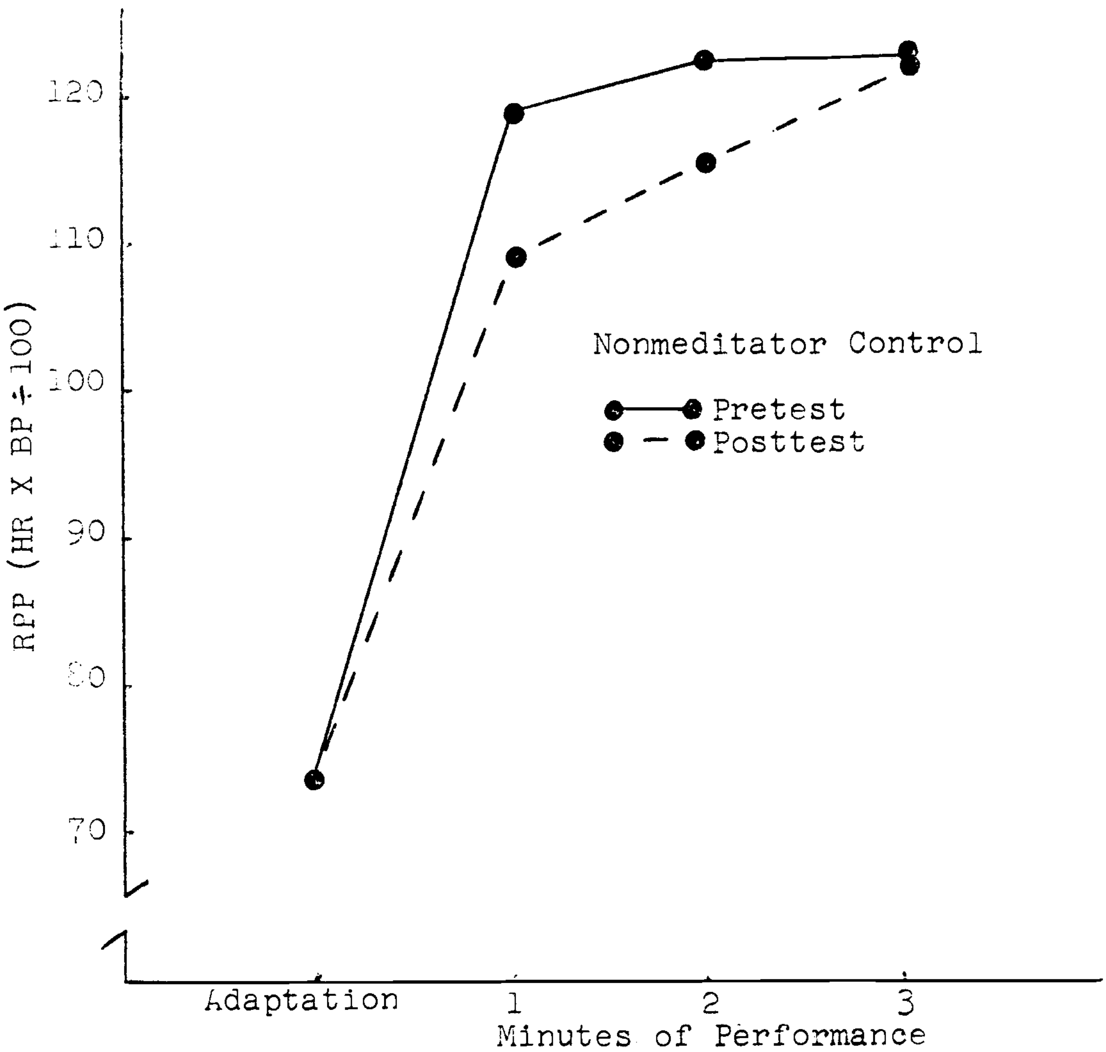

Figure 24

Bicycle Rate-Pressure Product Response Comparing Pretest and Posttest of Nonmeditators in the Control Group During Adaptation and the First Three Minutes of Performance

TABLE 30

ANALYSIS OF VARIANCE OF TRENDS
BICYCLE RATE-PRESSURE PRODUCT RESPONSE
COMPARING PRETEST AND POSTTEST
OF NONMEDITATORS IN THE CONTROL GROUP
DURING ADAPTATION THROUGH MINUTE THREE OF PERFORMANCE

Source of Variation	Mean Square	Df	F-Ratio
Total	579.95	63	
Pretest/ Posttest	714.70	15	
	333.10	1	0.45
Error	741.96	14	
Time Period	537.84	48	
	7896.00	3	180.35*
Linear	17287.20	1	246.81**
Quadratic	5476.00	1	110.08**
Cubic	924.80	1	80.03**
Interaction	96.56	3	2.21
Linear	0.31	1	0.01
Quadratic	264.06	1	5.31**
Cubic	25.31	1	2.19
Error	42.78	42	
Linear	70.04	14	
Quadratic	49.75	14	
Cubic	11.56	14	

*F of 2.85 needed for significance at .05 for df 3,42
**F of 4.60 needed for significance at .05 for df 1,14

From the previous analysis of data, the findings resulted in acceptance or rejection of hypothesis one and subhypotheses 1.1 and 1.2 which dealt with the pattern of physiological response to fine and gross motor tasks.

Hypothesis One was accepted. No uniform pattern of significant difference exists between meditators and nonmeditators in the pattern of physiological response to a fine motor and gross motor task.

Subhypothesis 1.1 was accepted. No uniform pattern of significant difference exists in the pattern of physiological response between subjects who have relaxed and subjects who have not relaxed immediately prior to a pursuit rotor task.

Subhypothesis 1.2 was accepted. No uniform pattern of significant difference exists in the pattern of physiological response between subjects who have relaxed and subjects who have not relaxed immediately prior to a bicycle task.

Level of Performance

Pursuit Rotor Task

Analysis of the trends of the trial means. An analysis of variance of the trends of the trial means of performance of five trials of the pursuit rotor task was performed. The criterion measure was the time on target for each trial. Tables 31a and 31b provide mean, standard deviation, and variance of the performance scores of the five trials.

Table 32 provids the F-ratio and description of significant difference in trends of performance found between meditators and nonmeditators in the pursuit rotor task. Figure 25 illustrates the difference shown in Table 32. Table 33 provides an analysis of variance table for the significant difference found.

Analysis of variance of the trends of the trial means of performance between meditators and nonmeditators for the pursuit rotor task showed a significant quadratic and cubic difference between experimental groups during the pretest.

TABLE 31a

MEAN, STANDARD DEVIATION, AND VARIANCE FOR PURSUIT ROTOR PERFORMANCE SCORES*

		Trial				
		1	2	3	4	5
Meditator						
Experimental						
Pretest	M	5.15	6.33	7.62	7.59	7.90
	SD	3.37	2.66	3.98	4.32	3.55
	V	11.35	7.09	15.83	18.65	12.63
Posttest	M	9.40	11.87	12.11	11.59	11.10
	SD	5.22	5.46	5.30	5.78	3.86
	V	27.29	29.85	28.09	33.45	14.87
Control						
Pretest	M	6.75	10.23	11.23	10.56	10.26
	SD	4.43	6.89	7.54	6.97	6.46
	V	19.66	47.40	56.79	48.59	41.77
Posttest	M	13.00	13.30	14.57	14.71	15.24
	SD	6.24	4.25	4.99	4.86	5.45
	V	38.92	18.09	24.94	23.63	29.71

*measured in seconds as length of time in contact with moving light per trial of 60 seconds

TABLE 31b

MEAN, STANDARD DEVIATION, AND VARIANCE FOR PURSUIT ROTOR PERFORMANCE SCORES*

		Trial 1	2	3	4	5
Nonmeditator						
Experimental						
Pretest	M	4.13	6.64	8.49	9.21	9.78
	SD	3.14	4.03	4.27	4.20	3.66
	V	9.89	16.21	18.25	17.61	13.43
Posttest	M	12.20	14.31	13.86	12.82	13.92
	SD	3.99	4.65	4.23	4.12	4.02
	V	15.96	21.60	17.93	16.97	16.20
Control						
Pretest	M	5.69	5.92	7.29	9.30	9.64
	SD	3.78	2.79	2.67	2.83	3.09
	V	14.26	7.77	7.14	8.02	9.58
Posttest	M	10.58	12.45	13.66	12.94	12.32
	SD	4.85	5.91	5.33	5.74	5.26
	V	23.49	34.91	28.39	32.92	27.70

*measured in seconds as length of time in contact with moving light per trial of 60 seconds

TABLE 32

SIGNIFICANT* COMPARISONS OF TREND
OF PURSUIT ROTOR TIME ON TARGET SCORES OVER FIVE TRIALS
BETWEEN MEDITATORS AND NONMEDITATORS

	Linear	Quadratic	Cubic	Quartic
Meditator/ Nonmeditator				
Experimental				
Pretest		F 6.74	F 7.30	
Posttest				
Control				
Pretest				
Posttest				

*F of 4.60 needed for significance at .05 for df 1,14

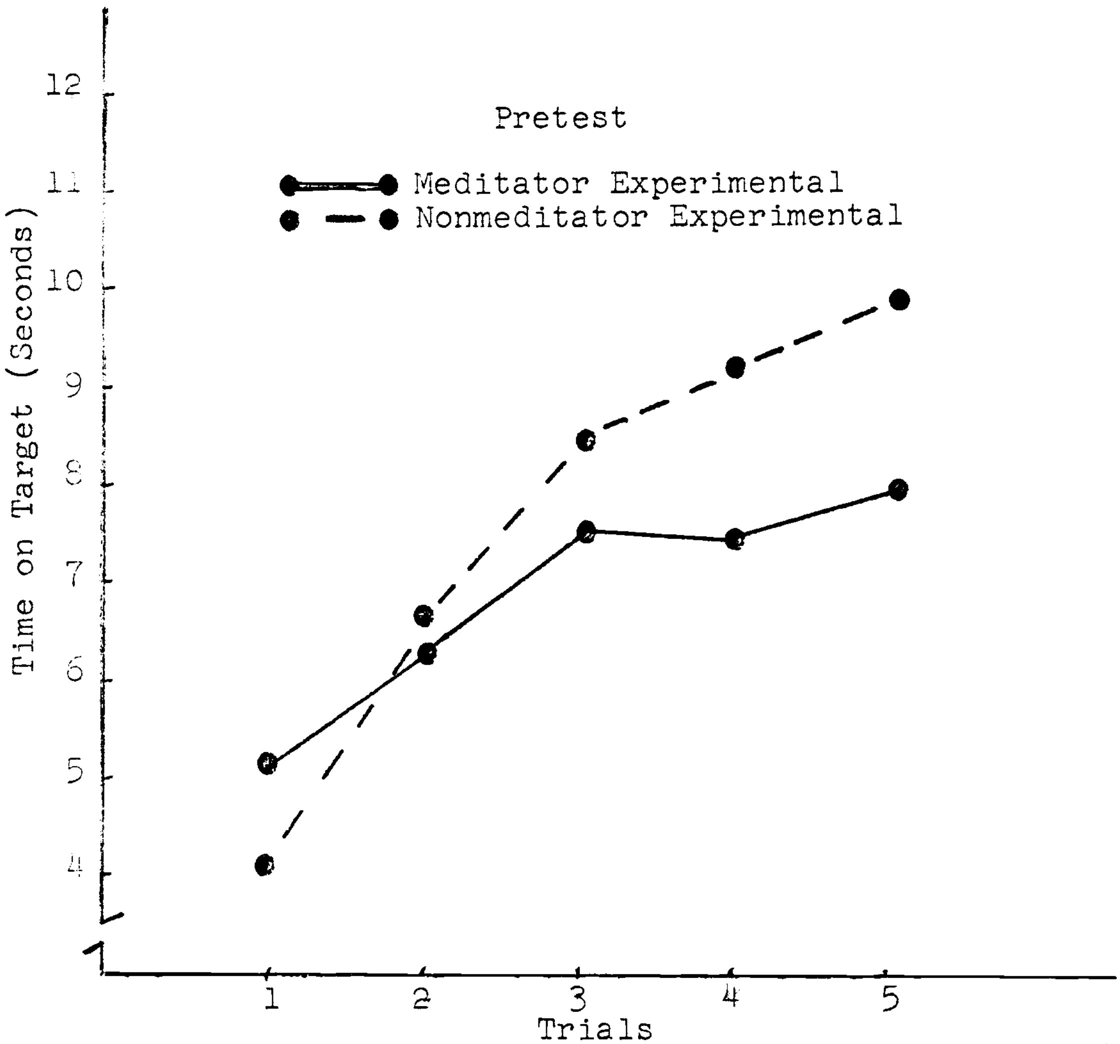

Figure 25

Pursuit Rotor Time On Target Performance Scores Comparing Meditators and Nonmeditators in the Experimental Condition During the Pretest

TABLE 33

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR PERFORMANCE SCORES
COMPARING MEDITATOR AND NONMEDITATOR EXPERIMENTAL GROUPS
DURING THE PRETEST

Source of Variation	Mean Square	Df	F-Ratio
Total	26.97	79	
Meditator/ Nonmeditator	115.95	15	
	98.17	1	0.84
Error	117.22	14	
Time Period	6.11	64	
	39.55	4	11.93
Linear	139.16	1	22.13*
Quadratic	18.96	1	4.57
Cubic	0.01	1	0.01
Quartic	0.07	1	0.07
Interaction	11.83	4	3.57
Linear	6.15	1	0.98
Quadratic	27.95	1	6.74*
Cubic	12.86	1	7.30*
Quartic	0.34	1	0.32
Error	3.32	56	
Linear	6.29	14	
Quadratic	4.15	14	
Cubic	1.76	14	
Quartic	1.07	14	

*F of 4.60 needed for significance at .05 for df 1,14

Comparisons of experimental and control groups showed a significant quadratic difference for nonmeditators during the pretest. No significant difference was found for the posttest. Figure 26 illustrates the significant difference found in the trends of performance scores between experimental and control groups of nonmeditators during the pretest. An analysis of variance table is provided in Table 34.

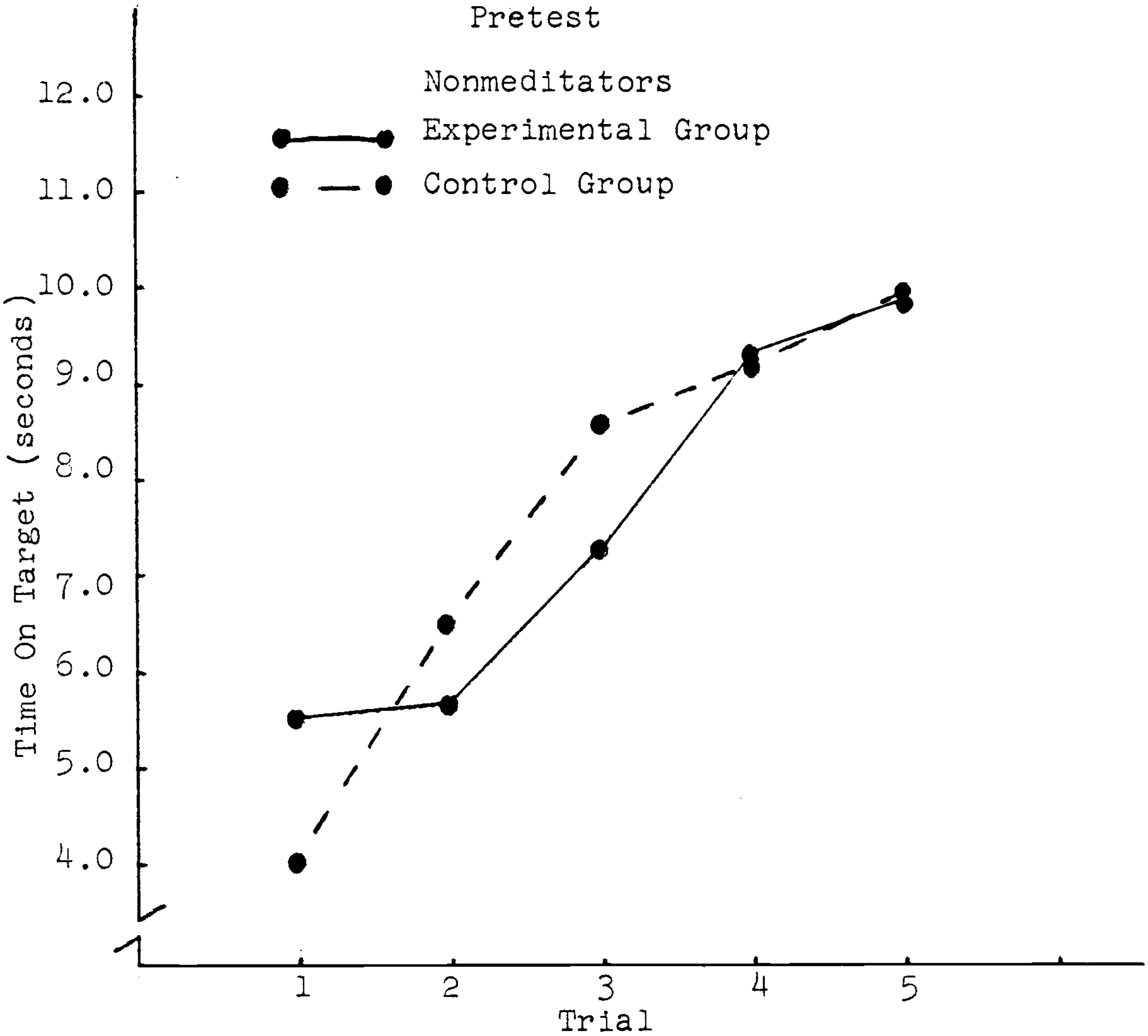

Figure 26

Pursuit Rotor Time On Target Performance Scores Comparing Experimental and Control Groups of Nonmeditators During the Pretest

TABLE 34

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR PERFORMANCE SCORES
COMPARING EXPERIMENTAL AND CONTROL GROUPS
OF NONMEDITATORS
DURING THE PRETEST

Source of Variation	Mean Square	Df	F-Ratio
Total	14.34	79	
Experimental/ Control	44.47	15	
	0.12	1	0.01
Error	47.64	14	
Time Period	7.28	64	
	65.03	4	19.35*
Linear	253.16	1	28.75**
Quadratic	4.83	1	2.40
Cubic	2.14	1	1.31
Quartic	0.01	1	0.01
Interaction	4.38	4	1.30
Linear	2.67	1	0.30
Quadratic	9.80	1	4.88**
Cubic	4.45	1	2.71
Quartic	0.61	1	0.61
Error	3.36	56	
Linear	8.81	14	
Quadratic	2.01	14	
Cubic	1.64	14	
Quartic	0.99	14	

*F of 2.55 needed for significance at .05 for df 4,56
**F of 4.60 needed for significance at .05 for df 1,14

Table 35 provides F-ratios and descriptions of significant difference found in pretest and posttest comparisons of the trends of the trial means of performance of the pursuit rotor task. Figures 27a and 27b illustrate the significant difference in trends presented in Table 35. Analysis of variance tables are provided for each significant difference in trends (Tables 36a and 36b).

Analysis of pretest and posttest comparisons of trends of the trial means of performance of the pursuit rotor task showed a quadratic difference for experimental nonmeditators. A linear difference in trend was found for control nonmeditators comparing pretest and posttest performance values.

TABLE 35

SIGNIFICANT* COMPARISONS OF TREND
OF PURSUIT ROTOR TIME ON TARGET SCORES OVER FIVE TRIALS
BETWEEN PRETEST AND POSTTEST

	Linear	Quadratic	Cubic	Quartic
Pretest/ Posttest				
Meditator				
Experimental				
Control				
Nonmeditator				
Experimental		F 15.11		
Control	F 7.82			

*F of 4.60 needed for significance at .05 for df 1,14

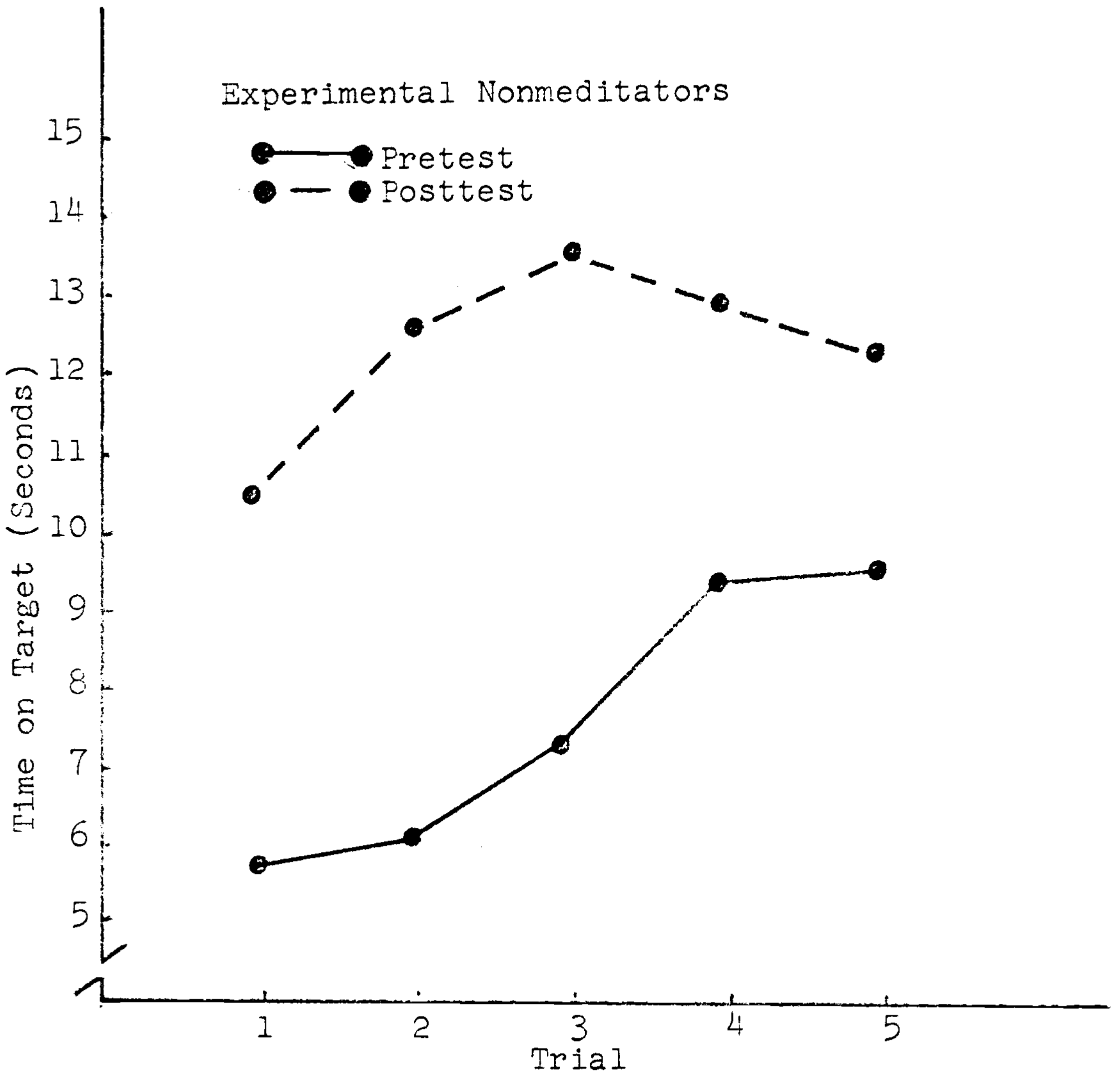

Figure 27a

Pursuit Rotor Time On Target Performance Scores Comparing Pretest and Posttest of Nonmeditators in the Experimental Group

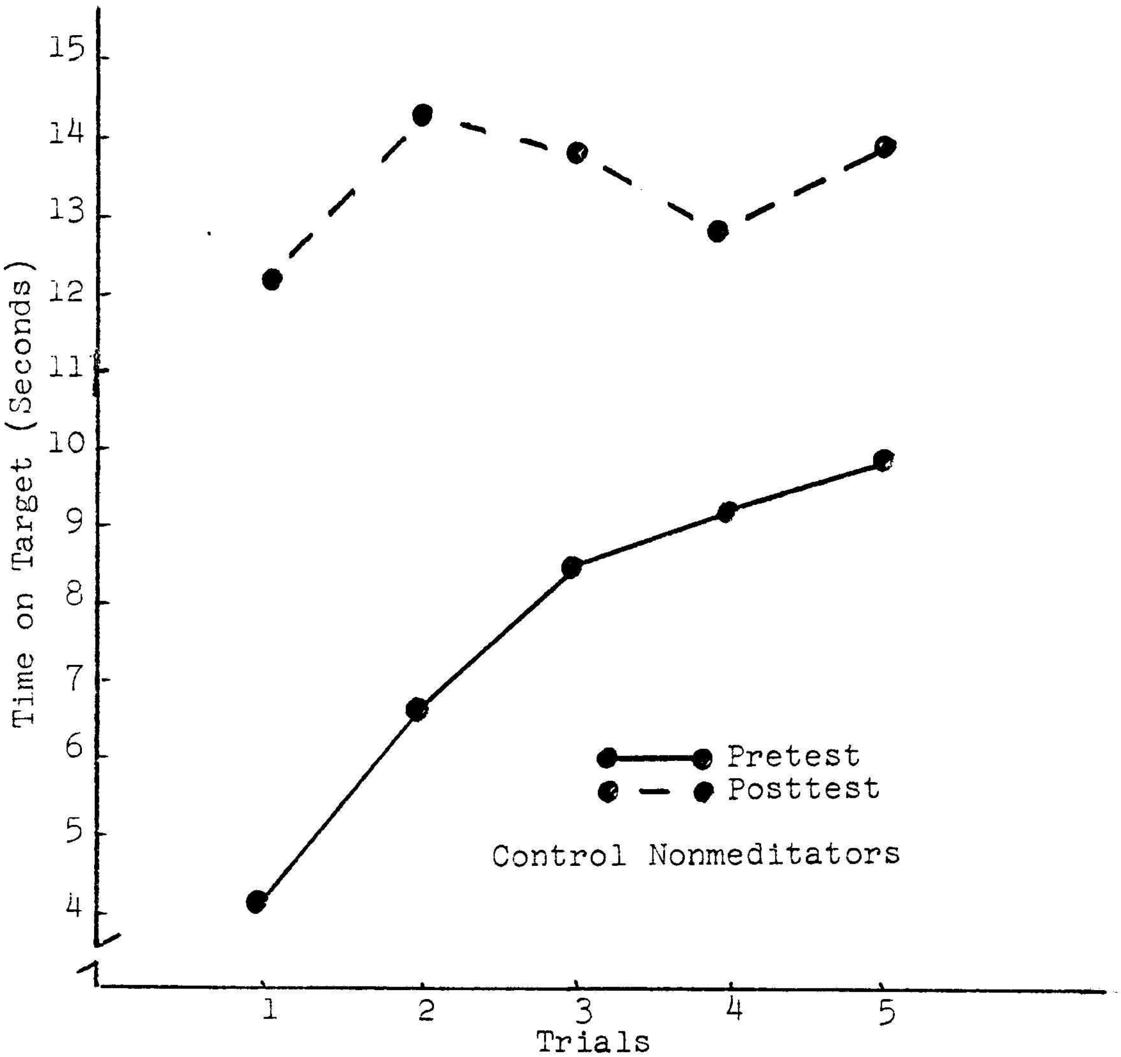

Figure 27b

Pursuit Rotor Time on Target Performance Scores Comparing Pretest and Posttest of Nonmeditators in the Control Group

TABLE 36a

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR PERFORMANCE SCORES
COMPARING PRETEST AND POSTTEST
OF NONMEDITATORS IN THE EXPERIMENTAL GROUP

Source of Variation	Mean Square	Df	F-Ratio
Total	24.99	79	
Pretest/ Posttest	108.15	15	
	464.46	1	5.62
Error	82.70	14	
Time Period	5.50	64	
	26.33	4	7.32*
Linear	93.13	1	10.96**
Quadratic	10.34	1	9.08**
Cubic	1.70	1	1.00
Quartic	0.13	1	0.04
Interaction	11.32	4	3.14
Linear	21.41	1	2.52
Quadratic	17.21	1	15.11**
Cubic	5.15	1	3.02
Quartic	1.49	1	0.49
Error	3.60	56	
Linear	8.50	14	
Quadratic	1.14	14	
Cubic	1.71	14	
Quartic	3.05	14	

*F of 2.55 needed for significance at .05 for df 4,56
**F of 4.60 needed for significance at .05 for df 1,14

TABLE 36b

ANALYSIS OF VARIANCE OF TRENDS
PURSUIT ROTOR PERFORMANCE SCORES
COMPARING PRETEST AND POSTTEST
OF NONMEDITATORS IN THE CONTROL GROUP

Source of Variation	Mean Square	Df	F-Ratio
Total	25.42	79	
Pretest/ Posttest	108.08	15	
	666.72	1	9.78*
Error	68.18	14	
Time Period	6.05	64	
	31.88	4	9.21**
Linear	99.95	1	13.73*
Quadratic	16.38	1	4.98*
Cubic	10.91	1	4.50
Quartic	0.28	1	0.33
Interaction	16.42	4	4.74**
Linear	56.95	1	7.82*
Quadratic	1.64	1	0.50
Cubic	7.06	1	2.92
Quartic	0.31	1	0.04
Error	3.46	56	
Linear	7.28	14	
Quadratic	3.29	14	
Cubic	2.42	14	
Quartic	0.85	14	

*F of 4.60 needed for significance at .05 for df 1,14
**F of 2.55 needed for significance at .05 for df 4,56

Analysis of the means of performance. An analysis of variance of the means of performance of the sum of the five trials for the pursuit rotor task was performed. The criterion measure was the mean time on target of the sum of the five trials. All groups improved their scores from the pretest to the posttest demonstrating a learning effect. An interaction effect between meditators and nonmeditators was obtained for the experimental group. Applying Tukey's procedure for pairwise comparisons showed no significant difference between groups in performance scores. Similarly no significant difference was found between other comparisons: meditators and nonmeditators, in the control condition, pretest and posttest in performance scores of the pursuit rotor task.

Table 37 provides an analysis of variance table reflecting the results of the analysis of the means of performance of the sum of the five trials for the pursuit rotor task.

TABLE 37

ANALYSIS OF VARIANCE
PURSUIT ROTOR PERFORMANCE SCORES

Source of Variation	Mean Square	Df	F-Ratio
E/C	26.33	1	0.76
M/NM	2.82	1	0.81
Interaction	27.60	1	0.80
Error	34.62	28	0.76
Pre/Post	549.96	1	98.56*
E/C X Pre/Post	1.41	1	0.25
M/NM X Pre/Post	6.08	1	1.09
Interaction Pre/Post X E/C X M/NM	26.82	1	4.81*
Residual	5.58	28	98.56

*F of 4.20 needed for significance at .05 for df 1,28

Bicycle Task

An analysis of variance of between group means was performed on the length of time subjects performed the bicycle task before reaching 70% of their age predicted maximum heart rate. The range of performance was seven to 18 minutes. Table 38 provides the mean, standard deviation, and variance of performance scores for all groups of subjects during the pretest and posttest. No significant difference was found in levels of performance between meditators and nonmeditators in the experimental and control conditions, pretest and posttest for the bicycle task.

TABLE 38

MEAN, STANDARD DEVIATION, AND VARIANCE FOR BICYCLE PERFORMANCE SCORES*

	Mean	Standard Deviation	Variance
Meditators			
Experimental			
Pretest	11.50	3.02	9.14
Posttest	11.63	3.81	14.55
Control			
Pretest	12.13	3.87	14.98
Posttest	12.25	3.92	15.36
Nonmeditators			
Experimental			
Pretest	10.38	4.07	16.55
Posttest	10.75	4.02	16.21
Control			
Pretest	10.63	3.07	9.41
Posttest	11.38	3.50	12.27

*Measured as length of time of performance to reach target heart rate of 70% age predicted maximum

Relationship of Performance to Physiological Response

Regression coefficients of multiple correlations were computed with the pursuit rotor and bicycle data in order to establish the relationship of performance to physiological response. The independent variables were the physiological measures of heart rate, blood pressure, frontalis EMG and, for the bicycle task, rate-pressure product. The dependent variables were the performance scores of time on target for the pursuit rotor task, and the length of performance time until the subject reached the target heart rate of 70% age predicted maximum for the bicycle task. Independent variables were analyzed by time periods for correlation with the dependent variable.

Variables were subjected to a stepwise multiple regression analysis. The stepwise multiple regression analysis provides a coefficient of multiple correlation or R and an F-test of statistical significance. The R establishes the degree or extent that several independent variables taken together can be a predictive measure of the dependent variable. Since R may be the result of chance or sampling error, an analysis of significance of R (F-test) is computed. A significant F-ratio indicates that a significant linear relationship exists between the dependent variable and the independent variables identified.

A significant correlation was noted where the F-ratio was significant to the .05 level and correlations were at or above .85.

Pursuit Rotor Task

Tables 39 through 41 present the regression coefficients of multiple correlations of performance and physiological measures for the pursuit rotor task. Significant correlations exist pretest and posttest for heart rate, blood pressure, and frontalis EMG. However, no conclusive pattern which would suggest predictability of performance and physiological measures for the pursuit rotor task are shown.

TABLE 39a

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS
OF HEART RATE RESPONSE AND TIME ON TARGET
FOR THE PURSUIT ROTOR TASK DURING THE PRETEST

	Trial	Adapt/ Antic.	H.R. 2,4,6	Recov. 1-5	Recov. 1,5	Recov. 2-4
Experimental Meditators	1					
	2					
	3					
	4					
	5					
Control Meditators	1	R .93	R.195			
	2	R .85				
	3					
	4	R .96				
	5					
Experimental Nonmeditators	1					
	2					
	3					
	4					
	5					
Control Nonmeditators	1					
	2					
	3					
	4					
	5					

*F test of significance at the .05 level and an R of .85 needed for a significant correlation

TABLE 39b

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS OF HEART RATE RESPONSE AND TIME ON TARGET FOR THE PURSUIT ROTOR TASK DURING THE POSTTEST

	Trial	Adapt/ Antic.	H.R. 2,4,6	Recov. 1-5	Recov. 1,5	Recov. 2-4
Experimental Meditators	1		R .97			
	2		R .97			
	3					
	4				R .88	
	5					
Control Meditators	1		R .99			
	2					
	3	R .86				
	4	R .93				
	5					
Experimental Nonmeditators	1					
	2					
	3					
	4					
	5					
Control Nonmeditators	1					R .92
	2					
	3					
	4					
	5					

*F test of significance at the .05 level and an R of .85 needed for a significant correlation

TABLE 40a

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS OF BLOOD PRESSURE RESPONSE AND TIME ON TARGET FOR THE PURSUIT ROTOR TASK DURING THE PRETEST

	Trial	Adaptation	Trial	Recovery
Experimental Meditators	1		R .89	
	2	R .91		R .90
	3	R .86		
	4	R .85		
	5			
Control Meditators	1			
	2			
	3			
	4			
	5			
Experimental Nonmeditators	1			
	2			
	3			
	4			
	5			
Control Nonmeditators	1			
	2			
	3			
	4			
	5			

*F test of significance at the .05 level and an R of .85 needed for a significant correlation

TABLE 40b

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS OF BLOOD PRESSURE RESPONSE AND TIME ON TARGET FOR THE PURSUIT ROTOR TASK DURING THE POSTTEST

	Trial	Adaptation	Trial	Recovery
Experimental Meditators	1	R .85	R .90	R .86
	2			
	3	R .85	R .87	R .90
	4		R .86	R .88
	5		R .87	
Control Meditators	1	R .97		
	2			
	3	R .85		
	4	R .92		
	5	R .95		
Experimental Nonmeditators	1			
	2			
	3			
	4			
	5			
Control Nonmeditators	1			R .89
	2			
	3	R .88	R .89	R .85
	4	R .95	R .89	
	5			

*F test of significance at the .05 level and an R of .85 needed for a significant correlation

TABLE 41a

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS OF FRONTALIS EMG RESPONSE AND TIME ON TARGET FOR THE PURSUIT ROTOR TASK DURING THE PRETEST

	Trial	Adaptation	Trial	Recovery
Experimental Meditators	1			
	2			R .99
	3			
	4			
	5			
Control Meditators	1			
	2			
	3			
	4			
	5			
Experimental Nonmeditators	1			
	2			
	3			
	4			
	5			
Control Nonmeditators	1			
	2			
	3	R .86		
	4			
	5	R .87		

*F test of significance at the .05 level and an R of .85 needed for a significant correlation

TABLE 41b

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS OF FRONTALIS EMG RESPONSE AND TIME ON TARGET FOR THE PURSUIT ROTOR TASK DURING THE POSTTEST

	Trial	Adaptation	Trial	Recovery
Experimental Meditators	1			
	2		R .94	
	3		R .93	
	4			
	5		R .92	
Control Meditators	1			R .99
	2			
	3			
	4			
	5			
Experimental Nonmeditators	1			
	2			
	3			
	4			
	5			R .99
Control Nonmeditators	1			
	2			
	3			
	4			
	5			

*F test of significance at the .05 level and an R of .85 needed for a significant correlation

Bicycle Task

Regression coefficients of multiple correlations of performance and physiological measures for the bicycle task are presented in Tables 42 through 45. No significant correlations were demonstrated for the frontalis EMG during the posttest. Significant correlations are noted for the frontalis EMG during the pretest and for the heart rate, blood pressure, and RPP during pretest and posttest. However, no conclusive pattern which would suggest predictability of performance and physiological measures for the bicycle task are shown.

TABLE 42a

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS OF HEART RATE AND TIME TO TARGET HEART RATE FOR THE BICYCLE TASK DURING THE PRETEST

	Meditators		Nonmeditators	
	Experimental	Control	Experimental	Control
Adapt/ Antic.	R. 93			
Min. 1-3	R .98			R .93
Interp Min 1-5				R .99
Interp Min 5-9				R .99
Interp Min 9-14				
Interp Min 15-20				R .99
Last HR/ Recov. 1	R .94			

*F test of significance at the .05 level and an R of .85 needed for a significant correlation

TABLE 42b

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS OF HEART RATE AND TIME TO TARGET HEART RATE FOR THE BICYCLE TASK DURING THE POSTTEST

	Meditators		Nonmeditators	
	Experimental	Control	Experimental	Control
Adapt/ Antic.	R .95			
Min 1-3	R .98	R .96	R .94	R .99
Interp Min 1-5		R .99		R .99
Interp Min 5-9		R .99		
Interp Min 9-14				
Interp Min 15-20				
Last HR/ Recov. 1			R .94	
Recov 1-5	R .99		R .99	
Recov 6-10				

*F test of significance at the .05 level and an R of .85 needed for a significant correlation

TABLE 43a

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS OF BLOOD PRESSURE AND TIME TO TARGET HEART RATE FOR THE BICYCLE TASK DURING THE PRETEST

	Meditators		Nonmeditators	
	Exper- imental	Control	Exper- imental	Control
Adapt/ Antic.		R .95		
Min 1-3				
Interp Min 1-5				
Interp Min 5-9				
Interp Min 9-14				
Interp Min 15-20				
Last BP/ Recov 1				R .87
Recov 1-5				
Recov 6-10		R .98		

*F test of significance at the .05 level and an R of .85 needed for a significant correlation

TABLE 43b

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS OF BLOOD PRESSURE AND TIME TO TARGET HEART RATE FOR THE BICYCLE TASK DURING THE POSTTEST

	Meditators		Nonmeditators	
	Exper-imental	Control	Exper-imental	Control
Adapt/ Antic.				
Min 1-3			R .99	
Interp Min 1-5	R .99	R .99		
Interp Min 5-9	R .99	R .99		
Interp Min 9-14				
Interp Min 15-20				R .99
Last BP/ Recov 1		R .87		
Recov 1-5				
Recov 6-10	R .99			

*F test of significance at the .05 level and an R of .85 needed for a significant correlation

TABLE 44a

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS OF RPP AND TIME TO TARGET HEART RATE FOR THE BICYCLE TASK DURING THE PRETEST

	Meditators		Nonmeditators	
	Experimental	Control	Experimental	Control
Adapt/ Antic.				
Min 1-3	R .97			
Interp Min 1-5	R .99	R .99	R .99	R .99
Interp Min 5-9				
Interp Min 9-14				
Interp Min 15-20				
Last RPP/ Recov 1	R .90			R .89
Recov 1-5				
Recov 6-10				

*F test of significance at the .05 level and an R of .85 needed for a significant correlation

TABLE 44b

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS OF RPP AND TIME TO TARGET HEART RATE FOR THE BICYCLE TASK DURING THE POSTTEST

	Meditators		Nonmeditators	
	Exper-imental	Control	Exper-imental	Control
Adapt/ Antic.	R .91			
Min 1-3	R .92	R .91		R .91
Interp Min 1-5	R .99			R .99
Interp Min 5-9		R .99		R .99
Interp Min 9-14		R 1.00		
Interp Min 15-20				
Last RPP/ Recov 1		R .89		
Recov 1-5				
Recov 6-10				

*F test of significance at the .05 level and an R of .85 needed for a significant correlation

TABLE 45

SIGNIFICANT* CORRELATIONS BETWEEN TRENDS OF FRONTALIS EMG AND TIME TO TARGET HEART RATE FOR THE BICYCLE TASK DURING THE PRETEST

	Meditators		Nonmeditators	
	Experimental	Control	Experimental	Control
Adapt/ Antic.				
Min 1-3				
Interp Min 1-5				
Interp Min 5-9			R .99	R .99
Interp Min 9-14				
Interp Min 15-20				
Last EMG/ Recov 1				
Recov 1-5				
Recov 6-10		R .99	R .99	

*F test fo significance at the .05 level and an R of .85 needed for a significant correlation

From the previous analysis of data, the findings resulted in acceptance or rejection of hypothesis two and Subhypotheses 2.1 and 2.2 which dealt with the performance of a fine motor and gross motor task.

Hypothesis Two was accepted. No significant difference exists between meditators and nonmeditators in the performance of a fine motor and gross motor task.

Subhypothesis 2.1 was accepted. No significant difference exists in the levels of performance between subjects who have relaxed and subjects who have not relaxed immediately prior to a pursuit rotor task.

Subhypothesis 2.2 was accepted. No significant difference exists in the levels of performance between subjects who have relaxed and subjects who have not relaxed immediately prior to a bicycle task.

Discussion

The results of this study indicate long term history of a relaxation practice (TM) or immediate prior meditation/relaxation do not alter the pattern of physiological response during performance of two levels of motor stress. The level of performance of a fine motor or gross motor task does not appear to be affected by long term history or immediate prior meditation/relaxation. No consistant pattern reflecting predictability of performance from physiological response was apparent from the results of this study.

A pattern of meditating everyday over a period of time, specifically the practice of TM, may not alter the pattern of physiological response during performance of motor tasks, but lower physiological values (HR, BP) do appear to be maintained as a pattern of response. This is supported by Benson (1974), Gellhorn (1972), and Wallace and Benson (1972).

Michaels (1976) and Warrenburg, et al (1977) concluded there was no difference between meditators and subjects who sat with eyes closed. This may hold for a meditation/relaxation period as in the Michaels and Warrenburg, et al study. However, the evidence that long term history of meditation/relaxation changes state effects into traits in time, creating reduced activation levels appears to be supported (Pagano, et al, 1976).

Examination of heart rate analysis reveals several pretest differences. Pretest differences occurred between experimental and control groups as well as between meditators and nonmeditators. Pretest differences were not consistent between groups and did not hold during the posttest. The differences between groups could not be attributed to the history of relaxation practice of immediate prior meditation/relaxation.

Meditators did not show greater anticipatory response than nonmeditators in the pursuit rotor task heart rate response, as in a study measuring heart rate in passive reaction to a stressor (Goleman and Schwartz, 1976). Meditators in experimental and control conditions did show a difference in trends of heart rate response during adaptation and anticipation of each trial comparing pretest to posttest. Experimental meditators reduced their level of activation. Control meditators were not consistent in the direction of change in level of activation.

Means of heart rate response to the pursuit rotor task (Table 2.1) illustrate an increase in the level of cardiac response in anticipation of trials (Cohen and Obrist, 1975; Little, 1977; Schwartz and Higgins, 1971).

Blood pressure response trends to the pursuit rotor task did not reflect a difference between groups pretest and posttest. Pretest difference between experimental and control meditators were eliminated in the posttest. Though not a significant difference, control meditators showed a posttest decrease, and experimental meditators showed a posttest increase in blood pressure response. Blood pressure absolute values appear to be higher for nonmeditators as supported by Benson and Wallace (1972), Benson, et al (1973) and Blackwell, et al (1975).

The recovery period did not show a quicker return to baseline (adaptation) by meditators as found by Patel (1977). The act of taking blood pressure itself may have altered the reading and may have contaminated the results of this study (Rushmer, 1976).

No significant trend difference was found in frontalis EMG response to the pursuit rotor task between groups pretest and posttest. Pretest differences existed between several groups which did not hold for the posttest. Comparisons of controls in both meditator and nonmeditator groups appear to have lower absolute values during the pretest and posttest than their experimental counterparts. A common response pattern was not found between heart rate and frontalis EMG as suggested by Jacobsen (1970), Sainsbury and Gibson (1954), and Stoyva and Budzynski (1974).

No significant difference in heart rate response to the bicycle task during adaptation through minute three was shown between groups. Goleman and Schwartz (1976) concluded meditators have greater anticipatory arousal than nonmeditators. The Goleman and Schwartz study was based on passive reaction to a stressor, not a stress reaction during a motor task.

The last performance heart rate through recovery time period for the bicycle task reflected the greatest difference in heart rate response trends. Pretest differences however did not consistently show in the posttest and results could not support the existence of a difference between groups.

Blood pressure response trend difference was greater during the bicycle task than the pursuit rotor task. Absolute values of blood pressure response showed less variance between groups. Control nonmeditators were the exception with higher blood pressure values initially and through much of performance. No pattern of difference appeared which would reflect a difference between groups in blood pressure response to the bicycle task.

No consistent pattern of difference in trends of frontalis EMG response appeared between groups pretest and posttest. Absolute differences between controls and experimentals during the bicycle task were not as pronounced as during the pursuit rotor task.

Meditators in experimental and control conditions reflected increased frontalis EMG activity during the posttest. Nonmeditators were mixed in their response with a general reduction in activity overall.

Coupling of heart rate and blood pressure response did not appear to occur for the bicycle task. Heart rate patterns of response reflected difference in trends between several groups and time periods, though no consistent pattern emerged. Blood pressure on the other hand, appeared to have more consistency in trends between groups. This increased stability of response of blood pressure among subjects and between groups influenced the results of the analysis of trends of group mean comparisons of RPP where the only significant difference found was for control nonmeditators pretest to posttest.

Variation among subjects in relaxation technique studies was reported by Fidel (1977). Meditators are reported to have variable responses which Pagano, et al (1976) suggested occurred as state effects such as baseline measures. Meditators also have shown variation in response from day to day (trait effects).

These conclusions and the results of this study further support the concept of response stereotypy. Though meditators may reduce physiological activation levels as a result of long term history of meditating, they maintain an individual, idiosyncratic pattern of responding. Individualized perception of stress may still be an over riding force which affects the physiological pattern of response activation level. Relaxation, whether meditation (TM) or eyes-closed relaxation, does not appear to affect the pattern of physiological response during motor activity of a stressful nature. The benefits of immediate prior meditation/relaxation on response to motor stress are not apparent in this study. The benefits of a long term history of TM practice do not appear to have an effect upon the pattern of physiological response during motor stress.

Group comparisons of trends of the trial means of performance scores for the pursuit rotor reflect no consistent pattern which would demonstrate a difference between groups. Analysis of the means of the sum of the five trials of between group scores showed no difference between groups in performance of a pursuit rotor task. This result supported Williams and Vickerman (1976) who found no difference between meditation and eyes closed relaxation in the effect upon performance of a pursuit rotor task. Controls did not do better than meditators in performance of the pursuit rotor task in this study as in a study by Williams and Herbert (1976).

The experimenter in this study was concerned that the change in tension level from deep relaxation to the fine motor stress of the pursuit rotor would show a change in performance in early trials of the posttest for subjects in the experimental condition (Nideffer, 1970). Analysis of the performance scores did not show significant difference in performance in the affected time period. Two of the subjects in the experimental condition and one subject in the control condition immediately prior to performance of the posttest expressed their dislike for the pursuit rotor task.

The changes in length of performance time from pretest to posttest between groups were small increases. Control nonmeditators reflected the greatest increase from 10.63 minutes to 11.38 minutes. Subjects within groups varied widely in their fitness level and their extent of participation in regular exercise. Effort was made to balance the groups on the fitness level variable using the questionnaire (Appendix B). Differences in length of performance time on the bicycle task varied between experimental and control groups as well as meditators and nonmeditators. Experimental and control meditators during the pretest exhibited the greatest variance in performance scores. Variance within groups increased for the experimental meditators from pretest to posttest and control nonmeditators from pretest to posttest.

No conclusive pattern reflecting an effect of long term history or immediate prior meditation/relaxation on performance emerged from the results of this study.

The number of significant correlations of performance and physiological response was greater during the posttest than the pretest for the pursuit rotor. Meditators had more significant correlations than nonmeditators in each of the physiological variables, but no consistent pattern of correlations emerged which would indicate long term history or immediate prior meditation/relaxation had an effect on predictability of performance and physiological response.

No significant pattern of correlations emerged for the bicycle task. As in the pursuit rotor task, the number of significant correlations was greater during the posttest than the pretest. Meditators however did not show more significant correlations than nonmeditators in the bicycle task.

Every individual has their own idiosyncratic pattern of response (Patel, 1977). Individual cognitive appraisal of a stressful situation influences the level of activation of the physiological variables involved in the stress response (Lazarus, 1966; Lazarus, et al, 1965; Malmo, 1972; Mason, 1972; Stoyva, 1976). The degree of stereotypy varies among individuals as well as the direction (which physiological variable or variables elicit maximal activation in a stressful situation). This results in no single physiological measure correlating with others on a consistent reproducible basis. Nor can a single physiological measure serve as an index to the state of the other measures or the total arousal of the individual (Lacey and Lacey, (1958, Lewinsohn, 1956).

This study supports the finding that there is variation among subjects in how they will respond to a relaxation technique (Fidel, 1977). Prediction of performance based on physiological response may be difficult to achieve.

This study further supports the evidence that meditators have lower heart rates, and blood pressures (Benson, et al, 1973; Benson and Wallace, 1972). Though trends of physiological response did not differ between meditators and nonmeditators or between experimentals and controls, inference can be made that if individuals start with lower activation levels they will keep lower activation levels during motor stress.

Long term history of meditation/relaxation appears to change state effects of lowered activation into traits (Pagano, et al, 1976) in time creating reduced physiological activation levels outside of the meditation/relaxation period. The state effects created however do not affect the physiological pattern of response during fine or gross motor tasks. Similarly, immediate prior meditation/relaxation also does not appear to have an effect on the pattern of response during fine or gross motor tasks.

Neither long term nor immediate prior meditation/relaxation appear to have an effect on the level of performance of a fine motor or gross motor task. Predictability of performance of a fine motor or gross motor task from physiological response is not achieved as a result of long term history or immediate prior meditation/relaxation.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Purpose

The purpose of this study was to determine the effect of immediate prior meditation (TM) and relaxation on the pattern of physiological response and performance of a fine motor and gross motor task and whether the long term regular practice of a passive meditation technique (TM) produces a difference in the reaction to motor activity.

Methods

A pretest-posttest control group randomized blocks design was used in this study. Sixteen transcendental meditators with three or more years regular practice were selected as the meditation group. Subjects with no history of relaxation training were recruited and 16 nonmeditators selected to create matched pairs with subjects in the meditation group. Matching criteria were: sex, age, height, weight, current and customary activity level. Matched pairs of subjects were assigned to two groups with an attempt to balance matching criteria for each group. One group was randomly assigned to experimental procedures, the other group served as a control group.

Subjects performed a pretest and posttest on a pursuit rotor task and a bicycle task while being monitored for heart rate, blood pressure and frontalis EMG. Experimental subjects meditated (meditation group) or relaxed with eyes closed (nonmeditation group) immediately prior to the posttest.

Analysis of variance of trends was used to test the first hypothesis which dealt with the pattern of physiological response to the tasks. Analysis of variance was used to test the second hypothesis which dealt with the level of performance. A multiple regression analysis was used to test the third hypothesis which dealt with the relationship between performance and physiological response.

Results

The analysis of the data resulted in the following findings.

Hypothesis One was accepted. No significant difference exists between meditators and nonmeditators in the pattern of physiological response to a fine motor and gross motor task.

Subhypothesis 1.1 was accepted. No significant difference exists in the pattern of physiological response between subjects who have relaxed and subjects who have not relaxed immediately prior to a pursuit rotor task.

Subhypothesis 1.2 was accepted. No significant difference exists in the pattern of physiological response between subjects who have relaxed and subjects who have not relaxed immediately prior to a bicycle task.

Hypothesis Two was accepted. No significant difference exists between meditators and nonmeditators in the performance of a fine motor and gross motor task.

Subhypothesis 2.1 was accepted. No significant difference exists in the levels of performance between subjects who have relaxed and subjects who have not relaxed immediately prior to a pursuit rotor task.

Subhypothesis 2.2 was accepted. No significant difference exists in the levels of performance between subjects who have relaxed and subjects who have not relaxed immediately prior to a bicycle task.

Hypothesis Three was accepted. No significant difference exists between meditators and nonmeditators in the relationship of performance and physiological response to a fine motor and gross motor task.

Subhypothesis 3.1 was accepted. No significant difference exists in the relationship of performance and physiological response between subjects who have relaxed and subjects who have not relaxed immediately prior to a pursuit rotor task.

Subhypothesis 3.2 was accepted. No significant difference exists in the relationship of performance and physiological response between subjects who have relaxed and subjects who have not relaxed immediately prior to a bicycle task.

Conclusions

Within the limitations of the design and subjects used in this study, the following conclusions were drawn.

While repeated absolute differences were noted between meditators and nonmeditators and between experimental and control groups, the differences in pattern of physiological response appeared to be random between groups. No consistent pattern of difference exists between groups in any selected time period. Though effort was made to achieve equal groups through matching criteria, pretest differences existed between meditators and nonmeditators. Attributing those differences to the history of meditation was not valid due to the pretest difference between experimental and control groups of meditators observed even though effort was made to balance matching criteria and experience in meditation between groups.

The variance among subjects in their cognitive appraisal of the given stresses (Lazarus, 1966; Lazarus, et al, 1965, Stoyva, 1976) may be independent of meditation history or immediate prior meditation/relaxation. Patel (1977) discussed the tendency of individuals to possess idiosyncratic patterns of response; some being heart rate reactors, some blood pressure reactors, some stomach reactors. Within a given group of subjects, unless response stereotypy is controlled, physiological patterns of responding to a given stress may be so variable as to distort mean patterns.

Pursuit rotor performance did improve pretest to posttest demonstrating a learning effect which may have been facilitated by tension (Freeman, 1938). Long term history of a relaxation technique (TM) did not carry over to facilitate reduced muscle tension and improved pursuit rotor performance as suggested by Eason and Branks (1963) and Freeman (1933).

Analysis of the bicycle task performance scores showed no significant difference between groups. Though meditators performed longer than nonmeditators as a group during the pretest of the bicycle task

(11.81 minutes to 10.50 minutes respectively), the difference was not statistically significant. Some difference in length of performance could be expected due to the meditators lower initial cardiovascular activity. Differences pretest to posttest were minimal. The one week time period between pretest and posttest did not give subjects time to provide a conditioning effect, and the bicycle ergometer task is not considered to be a neuromuscular activity which is sensitive to practice and learning as the treadmill has shown to be (Balke, 1952).

The relationship of performance and physiological response did not show a consistent pattern reflective of predictability. Blood pressure showed the strongest relationship to performance on the pursuit rotor task with several time periods having significant correlations and several groups reflecting positive relationships. Pretest differences and posttest differences however did not show blood pressure to be any more or less a predictor for subjects with a history of meditation or subjects with immediate prior meditation/relaxation. Blood pressure did not show as strong a relationship to performance during the bicycle task.

Recommendations

For further study the following recommendations are made.

The circumstances during this study limited the number of subjects per group to eight. Statistical analysis of data with these few subjects requires a greater difference between groups in order to establish significance. An increase in the number of subjects per group might better reflect differences between groups.

Rushmer (1976) reports that the act of taking blood pressure may be stress producing in and of itself. The inflation of the cuff around the arm does cause a level of discomfort. Though blood pressure was taken after the heart rate measurement, subject anticipation of the blood pressure measurement may have altered heart rate. An alternate method of measuring blood pressure should be found which is not as potentially stress producing.

Other physiological measures could be added to the data which might contribute to the overall picture of physiological response to motor stress. GSR was found to be the most independent and most reproducible in a study done by Lacey and Lacey (1958). The bicycle task may not be as appropriate for this measure as the pursuit rotor due to the level of work. Oxygen consumption, however, appears an appropriate physiological variable for the bicycle task. Frontalis EMG has been criticized as a measure of general muscular tension (Basmajian, 1976) due to its potential to reflect other facial muscle activity such as swallowing, eye movement, movement of the jaws, etc. Other sites for electromyographic measurement could be considered.

Fine and gross motor activity were measured by the pursuit rotor and bicycle ergometer respectively. Other instruments could be considered which measure fine and gross motor activity.

Response stereotypy is a concern of this investigator. An attempt could be made to identify and isolate subjects by their ideiosyncratic pattern of response. Subjects could be recruited for study, for instance, who have been identified as hypertensives, as in the Patel study (1977), and measured during activity.

Many research studies have dealt with meditation and other forms of relaxation and their effect upon the passive reaction to stress. The need for further research in the area of physiological response during performance of activity is evident.

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APPENDICES

Appendix A

ACKNOWLEDGEMENT OF WILLINGNESS TO PARTICIPATE

I acknowledge the willingness to participate in a Relaxation and Motor Activity study being conducted at Oregon State University during Winter term, 1979. I understand the tasks to be performed will be those of participating on two different occasions in a strenuous stationary bicycle activity and manually tracking a moving light. The purpose of this study is to see if certain types of relaxation affect the body during activity.

During each activity heart rate and forehead muscle tension will be monitored by the use of electrodes taped to my torso and forehead. Blood pressure will also be taken.

Medical approval will be given prior to my participation in the activity portion of the study. A resting 12-lead ECG given by the experimenter and a Self Report Medical History will provide data for the medical approval.

The time involvement will be approximately three one-hour sessions. A relaxation period will be added for some subjects.

I give permission for the experimenter to use the data gained for experimental study, but the right of privacy will be respected and my name will be kept in strict confidence.

I understand that my commitment is not binding and I may withdraw from participation in the study at any time. Questions regarding this study will be answered on a one-to-one basis.

Signed ______________________________

Date ____________ Phone ____________

Address ____________________________

Appendix B-1

M

QUESTIONNAIRE - RELAXATION AND MOTOR ACTIVITY STUDY

Name ______________________________

Date ____________ Sex: M F Subject number ________

Birthdate ____________ Height __________ Weight ______

Address ______________________________

Phone ______________

1. How long have you regularly practiced Transcendental Meditation?

2. Please indicate dates and lengths of experience in rounding?

3. Please indicate dates and what advanced training you have received in the TM Siddhis program.

4. Do you have any physical disabilities which might interfere with your participation in a stressful stationary bicycle activity or manually tracking a moving light? Explain.

5. Have you ever used a pursuit rotor tracking device? Explain.

6. Have you ever been given a stress test on a bicycle ergometer or a treadmill? Explain.

7. Exercise
   a. Do you engage in sports?

      Which?

      How often?

   b. Have you competed in any sport within this last year?

      Which?

      When?

   c. Do you expect to be competing in a sport between January and March, 1979?

      Which?

page 2

d. Do you . . .

Run/Jog _____ miles/week _____ mile time _____

Ski: crosscountry _____ downhill _____

Swim: _____ miles/week _____

Bicycle _____ miles/week _____

Lift weights _____ times/week _____

Participate in a calisthenics program? _____

times/week _____

e. How far do you think you walk each day? _______________

f. Were you an athlete in high school _____ college _____

What sports? _______________

How many years? _______________

g. Is your occupation:

Sedentary _____

Inactive _____

Active _____

Heavy work _____

Appendix B-2

QUESTIONNAIRE - RELAXATION AND MOTOR ACTIVITY STUDY

Name ____

Date ____________ Sex: M F Subject number __________

Birthdate ____________ Height _________ Weight ________

Address ____

Phone ____________

1. Have you ever had any formal relaxation training? (eg. meditation, yoga, biofeedback) Yes ____ No ____

   What ____

   When ____

2. Do you practice a relaxation technique?

3. Do you have any physical disabilities which might interfere with your participation in a stressful stationary bicycle activity or manually tracking a moving light? Explain.

4. Have you ever used a pursuit rotor tracking device? Explain.

5. Have you ever been given a stress test on a bicycle ergometer or a treadmill? Explain.

6. Exercise
   a. Do you engage in sports?

      Which?

      How often?

   b. Have you competed in any sport within this last year?

      Which?

      When?

   c. Do you expect to be competing in a sport between January and March, 1979?

      Which?

d. Do you . . .

Run/jog _____ miles/week _____ mile time _____

Ski: crosscountry _____ downhill _____

Swim: _____ miles/week _____

Bicycle _____ miles/week _____

Lift weights _____ times/week _____

Participate in a calisthenics program? _____

times/week _____

e. How far do you think you walk each day? _______________

f. Were you an athlete in high school _____ college _____

What sports? ____

How many years? _____________________________________

g. Is your occupation:

Sedentary _____

Inactive _____

Active _____

Heavy work _____

Appendix C

SELF REPORT MEDICAL HISTORY FORM

Name ____

Date ____________ Sex: M F Subject number ________

Birthdate ____________ Height ________ Weight ________

Address ____

Phone ______________

1. Do you smoke tobacco?

   Cigarettes: How many ________ How many years ________

   Cigar: How many ________ How many years ________

   Pipe: How many times/day _____ How many years ________

   In case you have stopped, when did you? ____________

   Why?

2. What is your weight now? ____

   What was your weight one year ago? ____

   Are you dieting? ____ Why?

3. Do you have headaches?

   Never ___ Seldom ___ Occasionally ___ Frequently ___

4. Past history

   Have you ever had:
   _____ rheumatic fever
   _____ heart murmur
   _____ high blood pressure
   _____ any heart trouble
   _____ disease of the arteries
   _____ varicose veins
   _____ lung disease
   _____ asthma
   _____ allergies
   _____ injuries to back, knees, etc.
   _____ epilepsy
   Please explain any checked.

5. Have you recently had:
   _____ chest pain
   _____ shortness of breath
   _____ heart palpitations
   _____ cough on exertion
   _____ coughing of blood
   _____ back pain
   _____ swollen, stiff or painful joints
   _____ frequent urination
   Please explain any checked.

6. Family history
   Have any of your relatives had:
   _____ heart attacks
   _____ high blood pressure
   _____ too much cholesterol
   _____ diabetes
   _____ congenital heart disease
   _____ heart operations
   _____ other
   Please explain any checked.

7. Blood pressure
   Systolic _______ Diastolic _______

8. Resting 12-lead ECG attached.

Appendix D

INSTRUCTIONS TO PARTICIPANTS

Relaxation and Motor Activity Study

You are scheduled to participate in the study on relaxation and motor activity on the following dates.

Session 1 ______________________ at __________ (time)

Session 2 ______________________ at __________ (time)

All sessions will be held in room 124 Moreland Hall on the Oregon State University campus.

So that measurements taken will be as much as possible totally _you_, the following requests are made:

1. Do not meditate or purposefully relax for at least six hours prior to entering the lab.
2. Do not engage in strenuous or energetic bodily activity other than your usual activity the day of your session.
3. Have your last meal more than two hours prior to entering the lab.
4. Do not smoke, drink coffee, tea, coke, or take aspirin for three hours prior to entering the lab.
5. Do not take any drugs, recreational or medicinal, for 24 hours prior to your session.

<u>Clothing</u>

Shorts, teeshirt, tennis shoes and socks will be most comfortable for the activity. Warmer clothes for after the session is advisable.

Adhesive patches will hold the electrodes in place. Female subjects will be asked to remove their bra for placement of the electrodes.

<u>Illness</u>

If you are ill, please call and reschedule your appointment. It is not advisable to perform this activity while suffering with or recouperating from a cold, the flu, or other ailment. Normal menstruation will not affect your performance.

Thanks again for your help. If you have any questions, please call.

Candy Wood
753-0118 home
754-2311 office

Appendix E

DEC/436/006

PREDICTED MAXIMAL (100%) AND SUBMAXIMAL (90 and 70%) HR
FOR TREADMILL STRESS TESTING

	POOR			FAIR			GOOD		
AGE	100%	90%	70%	100%	90%	70%	100%	90%	70%
20	201	187	161	201	187	159	196	181	153
21	199	185	159	200	186	159	196	181	153
22	198	184	158	199	185	150	195	181	153
23	197	184	158	198	184	157	195	181	153
24	196	183	157	198	184	157	194	180	152
25	195	182	156	197	183	157	194	180	152
26	194	181	156	194	180	154	193	179	151
27	193	180	155	196	182	156	193	179	151
28	192	179	154	195	181	155	192	178	151
29	191	178	154	193	180	154	192	178	151
30	190	177	153	193	180	154	191	177	150
31	189	176	152	193	180	154	191	177	150
32	188	175	151	192	179	153	190	176	149
33	187	175	151	191	178	152	189	175	149
34	186	174	150	191	178	152	189	175	149
35	184	172	149	190	177	152	188	174	148
36	183	171	148	189	176	151	188	174	148
37	182	170	147	189	176	151	187	173	147
38	181	169	147	188	175	150	187	173	147
39	180	168	146	187	174	150	186	172	146
40	179	167	145	186	173	149	186	172	146
41	178	166	144	186	173	149	185	172	146
42	177	166	144	185	172	148	185	172	146
43	176	165	143	184	171	147	184	171	145
44	175	164	142	184	171	147	184	171	145
45	174	163	142	183	171	147	183	170	144
46	173	162	141	182	170	146	183	170	144
47	172	161	140	181	169	145	182	169	144
48	171	160	140	181	169	145	182	169	144
49	170	159	139	180	168	145	181	168	143

. . . . more

AGE	POOR 100%	90%	70%	FAIR 100%	90%	70%	GOOD 100%	90%	70%
50	168	157	137	179	167	144	180	167	142
51	167	157	137	179	167	144	180	167	142
52	166	156	136	178	166	143	179	166	142
53	165	155	135	177	165	143	179	166	142
54	164	154	135	176	164	142	178	165	141
55	163	153	134	176	164	142	178	165	141
56	162	152	133	175	163	141	177	164	140
57	161	151	133	174	162	140	177	164	140
58	160	150	132	174	162	140	176	163	139
59	159	149	131	173	162	140	176	163	139
60	158	148	130	172	161	139	175	163	139
61	157	148	130	172	161	139	175	163	139
62	156	147	129	171	160	138	174	162	138
63	155	146	128	170	159	138	174	162	138
64	154	145	128	169	158	137	173	161	137
65	152	143	126	169	158	137	173	161	137
66	151	142	126	168	157	136	172	160	137
67	150	141	125	167	156	136	171	159	136
68	149	140	124	167	156	136	171	159	136
69	148	139	123	166	155	135	170	158	135
70	147	139	123	165	154	134	170	158	135

Categories taken from fitness classification table.

Calculated by computer according to the formula given by Karvonen and Cooper.

FORMULA: $\frac{(HR^{-} \text{ max.} - RHR) \times 90 \text{ (or 70)}}{100} + RHR$

Appendix F

Luft Progressive
Bicycle Ergometer Performance Test

Subject ______________________ Date ______________ 19 ____

Date of Birth ____________________ Height __________ Weight ____________

Minute	Kp	Kpm. @ 50 Cpm.	Heart Rate	Blood Pressure Systolic	Diastolic$_4$	Diastolic$_5$
1	1	300				
2	1	300				
3	1	300				
4	1¼	375				
5	1½	450				
6	1 3/4	525				
7	2	600				
8	2¼	675				
9	2½	750				
10	2 3/4	825				
11	3	900				
12	3¼	975				
13	3½	1050				
* 14	3 3/4	1125				
15	4	1200				
16	4¼	1275				
17	4½	1350				
18	4 3/4	1425				
19	5	1500				
20	5¼	1575				
21	5½	1650				
22	5 3/4	1725				
23	6	1800				
24	6¼	1875				
25	6½	1950				
Seated Recovery		1				
		2				
		3				
		4				
		5				

Appendix G

SHOWER PASS

Please allow

____

to use the shower facilities on

____

as they are a participant in a research study with the Physical Education and Psychology departments.

____________________	____________________
investigator	Mr. Holsberry

Appendix H

POST MEDITATION/RELAXATION QUESTIONNAIRE

Subject number ________ Date ________ Time ________

1. Circle the number which best describes your success in meditating/relaxing in the laboratory today.

easy, very satisfactory		satisfactory		hard, not very satisfactory
1	2	3	4	5

2. Do you think you spent some time sleeping during the meditation/relaxation part of the period?

   Yes _____ No _____

   If yes, can you describe about when and about how long you slept?

   ____

   beginning ... end (20 min.)

3. Was there any physical unstressing? (Meditation subjects only.) Please describe.

4. Do you have any other feelings you wish to share about any part of the meditation/relaxation period?

Appendix I

PURSUIT ROTOR DATA

Subject number _____ Date _____ Test condition : ME MC NME NMC

Comments:

Test Period	Time	Blood Pressure Syst.	Diast.	Heart Rate	EMG	T-O-T
Baseline	1					
	2					
	3					
	4					
	5					
Anticipation	10sec					
Trial 1	2nd					
	4th					
	6th					
Interval 1						
Anticipation	10sec					
Trial 2	2nd					
	4th					
	6th					
Interval 2						
Anticipation	10sec					
Trial 3	2nd					
	4th					
	6th					
Interval 3						
Anticipation	10sec					
Trial 4	2nd					
	4th					
	6th					
Interval 4						
Anticipation	10sec					
Trial 5	2nd					
	4th					
	6th					
Interval 5						
Recovery	1 2nd					
	4th					
	6th					
	2 2nd					
	4th					
	6th					
	3 2nd					
	4th					
	6th					
	4 2nd					
	4th					
	6th					
	5 2nd					
	4th					
	6th					

Appendix J

BICYCLE ERGOMETER DATA

Subject number ______ Date ______ Test condition : ME MC NME NMC

Date of birth __________ Target heart rate _____ Time to THR _____

Comments:

Test Period	KpLoad 50 cpm	Time	Blood pressure Syst.	Diast.	H.R.	EMG	Comments
Baseline		1					
		2					
		3					
		4					
		5					
Hyperventilate							
Anticipation		10sec.					
Exercise	1	1					
	1	2					
	1	3					
	1 1/4	4					
	1 1/2	5					
	1 3/4	6					
	2	7					
	2 1/4	8					
	2 1/2	9					
	2 3/4	10					
	3	11					
	3 1/4	12					
	3 1/2	13					
	3 3/4	14					
	4	15					
	4 1/4	16					
	4 1/2	17					
	4 3/4	18					
	5	19					
	5 1/4	20					
Recovery		1					
		2					
		3					
		4					
		5					
		6					
		7					
		8					
		9					
		10					

Appendix K

MEDITATION/RELAXATION DATA

Subject number ________ Date _______ Time _______ M R

Comments:

Test period	Time	Blood Pressure Syst.	Diast.	H. R.	EMG	Comments
Adaptation/ Eyes Open	1					
	2					
	3					
	4					
	5					
Meditation/ Relaxation	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
Post Meditation/ Relaxation	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					