# VOLITIONAL CONTROL OF HEART RATE DURING EXERCISE STRESS

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN PHYSICAL EDUCATION IN THE GRADUATE SCHOOL OF THE TEXAS WOMAN'S UNIVERSITY

COLLEGE OF

HEALTH, PHYSICAL EDUCATION, AND RECREATION

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DENTON, TEXAS

AUGUST, 1971

Texas Woman's University

Denton, Texas

August 19 71

We hereby recommend that the dissertation prepared under our supervision by Victoria Ann LeFevers entitled Volitional Control of Heart Rate During Exercise Stress

be accepted as fulfilling this part of the requirements for the Degree of Doctor of Philosophy

Committee:

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Accepted:

Dean of Graduate Studies

## ACKNOWLEDGMENTS

The author is gratefully indebted to Doctor Joel Rosentswieg, director of this dissertation, for his personal contributions and interest. Further acknowledgments are extended to Doctor Virginia Jolly, Doctor Nick L. Lund, Doctor Bert E. Lyle, Jr., and Doctor Claudine Sherrill for their interest, assistance, and suggestions as members of the dissertation committee. Special gratitude is offered to Doctor Anne Schley Duggan whose life and contributions to the profession served constantly as encouragement and a challenge to the author.

Special recognition and gratitude is offered to my students who so willingly and faithfully gave of their time during the experimental sessions. To Marylou Schick, a most dedicated and professional student who served as laboratory assistant, appreciation is extended, not only for her contributions to science, but for her faithful optimism and encouragement. The author is particularly indebted to Evelyn Pack who gave so willingly of her time throughout the final preparation of the paper.

How can one acknowledge adequately one's parents for their constant support, love, encouragement, optimism? Deepest gratitude and love go to them, along with the dedication of this paper.

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# CHAPTER I

# INTRODUCTION TO THE STUDY

## Importance of the Problem

Throughout the history of man, philosophers thought that the voluntary responses of the skeletal muscles and reason were the involuntary glandular and visceral responses and emotions. The traditional belief that instrumental learning is possible only for voluntary control of skeletal responses and that only classical conditioning is possible for involuntary control of visceral and emotional responses has been questioned in recent years.

The dichotomy of the nervous system was formally proposed during the early nineteenth century by a French physiologist, Bichat (1800), who suggested that the controlling activities of the entire nervous system could be divided into a "voluntary" part and an "involuntary" part. As the result of the work of an American physiologist, Langley (1892), the existence of two specialized, yet interrelated, nervous systems was well established. The "voluntary" system was called the cerebrospinal nervous system, and the "involuntary" system was divided further into the sympathetic nervous system and the parasympathetic nervous system. Both systems--sympathetic and parasympathetic--Langley labeled the autonomic nervous system.

The autonomic nervous system serves three classes of effector organs: (1) smooth muscles, the muscles of the viscera, blood vessels, *et cetera*, which differ structurally from the skeletal muscles of the limbs and trunk; (2) cardiac muscle, which is specialized muscle that is continually in action throughout the life of the organism; and (3) the glands, which secrete various chemical products.

Just as the nervous system has been divided into a voluntary part and an involuntary part, so has the field of learning been divided traditionally into an involuntary form, or classical conditioning, and a higher voluntary form, operant or instrumental conditioning, a dichotomy which has been questioned in recent years. In involuntary response conditioning, the subject learns typically without conscious awareness of the change which is taking place. In an experimental situation, the response is under the control of the investigator who decides when and how the subject is to respond and then trains him to respond. The unconditioned stimulus serves also as the reinforcer. In instrumental conditioning, the subject must initiate the behavior--nothing is done by the investigator to elicit the response. After a correct response is made by the subject, a reward or reinforcement is applied. A particular response is required for reinforcement, and the responsibility for the response rests with the subject. The reinforcement follows, rather than precedes, the response. Therefore, the traditional belief that instrumental learning is possible only for voluntary control of skeletal responses and that only classical conditioning is possible for involuntary control of visceral responses developed. Miller described succinctly this traditional belief in the following way:

> . . .instrumental learning involved in the superior voluntary behavior is possible only for skeletal responses mediated by the superior cerebrospinal nervous system, while, conversely, the inferior classical conditioning is the only kind possible for the inferior, presumably involuntary, visceral and emotional responses mediated by the inferior autonomic nervous system (Miller, 1969:435).

Kimbell (1961) stated relatively recently that "for autonomically mediated behavior, the evidence points unequivocally to the conclusion that such responses can be modified by classical, but not instrumental, training methods." Miller (1941) refused to acknowledge a clear-cut dichotomy of learning because of the many similarities between classical conditioning and instrumental conditioning. He hypothesized that there is only one kind of learning, thus requiring experimental verification that instrumental conditioning was able to produce the learning of any visceral responses that could be acquired through classical conditioning.

Many investigators accepted the challenge that instrumental learning of visceral responses is possible. Several studies have been conducted utilizing instrumental learning in animals. In one of the first experiments reported, Donald Shearn (1962) modified heart rate in rabbits. Miller and Carmona (1967) brought the problem to the attention of the psychophysiological profession when they showed that the response of salivation (which is controlled autonomically) can be modified by an instrumental training procedure. In subsequent experiments various autonomic functions have been conditioned instrumentally in rats: heart rate (Trowill, 1967; Miller and DiCara, 1967; Ehrlich and Malmo, 1967; DiCara and Miller, 1968a; DiCara and Miller, 1968b; and DiCara and Miller, in press); intestinal contractions (Miller and Banuazizi, 1968); urine formation (Miller and DiCara, 1968); stomach contractions (Carmona, Miller, and Demierre; in preparation); peripheral vasomotor responses (DiCara and Miller, 1968b; DiCara and Miller, 1968d); blood pressure (DiCara and Miller, 1968c); emotionality (DiCara and Weiss, 1969); brain waves (Miller, 1966; Carmona, 1967); and glandular response (Miller, DiCara, and Wolf, 1968). The results of these studies upon animals led ultimately to investigations of operant conditioning of visceral responses in humans. Although several visceral responses have been tested, the more relevant studies with reference to heart rate will be reported in Chapter II.

These previous studies have indicated that heart rate responses mediated by the autonomic nervous system can be conditioned instrumentally, whether or not instrumental learning of heart rate can occur during exercise stress has not been determined. deVries (1966) states that "high heart rates are less efficient than low rates, other things being equal. . . . The slower the heart rate for any given workload, the more efficiently is the cardiac work performed." This is based upon three ideas: (1) oxygen consumption of the heart increases with increasing heart rate, even though the workload is held constant; (2) as the rate increases, the filling time of the heart decreases, and (3) diastasis, the only resting period for the myocardium, is disproportionately shortened in faster rates, and may disappear entirely at high rates (deVries, 1966:73). If a person is able to lower consciously her heart rate during exercise stress, the body may be able to adjust and work more efficiently. Thus, because of the possible adaptation of the body to the lower heart rate, several positive changes in performance could occur: (1) longer duration of effort before exhaustion; (2) greater utilization of energy reserves; and (3) more rapid return of heart rate and blood pressure to normal following activity. In essence, the volitional control of heart rate suggests the potential of less circulatory stress during physical activity (McArdle and Patti, 1967:76).

## Statement of the Problem

The investigation entailed a study of thirty-five women students who were enrolled in Eastern Illinois University, Charleston, Illinois, during the summer quarter of the academic year of 1970-1971, to determine if heart rate could be conditioned instrumentally and lowered during exercise stress induced by a measured amount of work upon a treadmill. The subjects were divided into three groups: Experimental Group I, who received instrumental conditioning with visual feedback; Experimental Group II, who were allowed to practice the volitional control of heart rate lowering in the same manner as the first experimental group but were not provided any immediate feedback or other information that would allow them to know the extent of their practice control until after the experimental period, when the subjects were told if they had reached the criterion of learning; and the Control Group, who received no conditioning. The number of experimental sessions numbered ten for all experimental subjects. Heart rate was measured by a Narco Bio-Systems Biotachometer before and after the experimental period of ten days. A conclusion was drawn concerning changes in the performance of heart rate lowering by subjects in both experimental groups in comparison with each other and in comparison with the Control Group.

## Definitions and/or Explanations of Terms

For the purpose of clarification, the investigator established the following definitions and/or explanations of terms for use in the study:

Heart Rate Lowering: In this study the term "heart rate lowering" referred to a decrease in the heart rate of the subject after receiving the conditioned stimulus. A ten per cent decrement of the resting pulse rate of the subject upon command was considered the level of acceptability.

<u>Exercise Stress</u>: This term referred to the accelerated heart rate of the subject as a result of work upon the treadmill.

<u>Instrumental Conditioning</u>: The investigator accepted the explanation of DiCara who states that:

> In this process a reinforcement, or reward, is given whenever the desired conditioned response is elicited by a conditioned stimulus (such as a certain signal). . . . In instrumental learning . . . the reinforcement strengthens any immediately preceding response; a given response can be reinforced by a variety of rewards and a given reward can reinforce a variety of responses (DiCara, 1970).

In this investigation, the reinforcement for Experimental Group I was the immediate visual display of being able to see the heart rate decrease to the acceptable level upon the dial of the Narco Bio-Systems Biotachometer, BT-1200, and the reinforcement for Experimental Group II was delayed verbal feedback given after the experimental period, but prior to the post-tests.

## Delimitations of the Study

This study was subject to the following delimitations:

1. Thirty-five women students enrolled in Eastern Illinois University, Charleston, Illinois,

during the summer quarter of the academic year of 1970-1971.

2. Participation of the subjects in one-half hour experimental sessions in which they attempted to lower their heart rates during a resting state each day for a maximum of ten days.
3. The extent to which heart rate lowering can be conditioned through instrumental learning during exercise stress.

## Purposes of the Study

The general purpose of the study was to determine if heart rate lowering could be instrumentally conditioned during exercise stress. Specifically, the following null hypothesis was tested: There is no significant difference in heart rate lowering of those subjects in Experimental Group I who received instrumental conditioning with immediate feedback, in Experimental Group II who received instrumental conditioning with delayed feedback, and in the Control Group who received no conditioning.

## Summary

Much controversy exists with reference to the traditional belief that instrumental learning is possible only for voluntary control of skeletal responses, and that classical conditioning is possible only for involuntary control of visceral and emotional responses. The assumption that visceral responses cannot be learned in the same way as can skeletal responses has been refuted recently by research. Miller has postulated that there is only one kind of learning, therefore visceral responses can be learned just as skeletal responses can be learned. Research has shown positive results with reference to the instrumental learning of visceral responses of animals and human beings.

The purpose of this investigation was to determine if heart rate lowering could be instrumentally conditioned under exercise stress. The investigator hypothesized that there would be no significant difference in heart rate lowering of those subjects in the Experimental Group I who received instrumental conditioning with immediate visual feedback, of those subjects in Experimental Group II who received instrumental conditioning with delayed verbal feedback, and those subjects in the Control Group who received no conditioning.

Thirty-five students from Eastern Illinois University were selected to participate in the study. The subjects were divided into three groups, Experimental Group I who received instrumental conditioning with immediate visual feedback, Experimental Group II, who received instrumental conditioning and delayed verbal feedback, and the Control Group who received no conditioning. The number of experimental sessions numbered ten for all experimental subjects.

Chapter II presents a review of the literature that was found pertinent to the investigation.

# CHAPTER II

## REVIEW OF RELATED LITERATURE

### Introduction

Throughout the history of man, a dichotomy of bodily functions was present--the superior of these being the voluntary responses of the skeletal muscles and reason, leaving the involuntary glandular and visceral responses and emotions as the inferior functions. Even as long ago as the age of the famous Greek philosopher, Plato, has this division been shown. Plato (Jowett, 1895) envisioned man as consisting of a head containing the "superior rational soul," and a body containing other "inferior souls."

During the early eighteenth century, a French physiologist, X. Bichat (1800), introduced formally his bi-partition of the nervous system. Miller (1969) presents a condensation of the concepts of Bichat:

> . . . Bichat distinguished between the cerebro-spinal nervous system of the great brain and spinal cord, controlling skeletal responses, and the dual chain of ganglia (which he called "little brains") running down on either side of the spinal cord in the body below and controlling emotional and visceral responses. He indicated his low opinion of the ganglionic system by calling it "vegetative"; he also believed it to be largely independent of the cerebrospinal system, an opinion which is still reflected in our modern name for it, the autonomic nervous system (Miller, 1969).

Similarly, most learning theorists differentiate between two types of learning. The first and more elementary form--classical conditioning or Pavlovian conditioning--is thought to be involuntary and therefore inferior. The second form--instrumental or operant conditioning--is clearly under voluntary control and therefore superior to the classical conditioning. Traditionally, the belief has been held that the involuntary visceral responses can be modified only by the corresponding inferior form of learning--classical conditioning. It was also felt that the viscera could not respond to the more superior operant conditioning because it would modify only the voluntary, skeletal responses. But this distinction was not supported by all learning theorists. Neal E. Miller of Rockefeller University for many years has held the concept that there is only one kind of learning. He explains this belief:

> The belief that instrumental learning is possible only for the cerebrospinal system and, conversely, that the autonomic nervous system can be modified only by classical conditioning has been used as one of the strongest arguments for the notion that instrumental learning and classical conditioning are two basically different phenomena rather than different manifestations of the same phenomenon under different conditions. But for many years I have been impressed with the similarity between the laws of classical conditioning and those of instrumental learning, and with the fact that, in each of these two situations, some of the specific details of learning vary with the specific conditions of learning. Failing to see any clear-cut dichotomy, I have assumed that there is

> only one kind of learning. This assumption has logically demanded that instrumental training procedures be able to produce the learning of any visceral responses that could be acquired through classical conditioning procedures. (Miller, 1969:435)

With this theory as the precedent and the challenge of Miller as an incentive, many investigators embarked upon the supposition that the instrumental learning of visceral responses is possible.

## Operant Conditioning in Animals

Donald Shearn (1961:456) was one of the first to conduct an experiment with reference to the instrumental learning of visceral responses. He concluded that the activity of the heart changes significantly in amplitude and rate when conditioned stimuli are present. In subsequent studies, Shearn (1962) and Shearn and Clifford (1964) modified heart rate in humans and rabbits by instrumental techniques. Miller and Carmona (1967:1) felt the above results were probably the result of skeletal responses, such as breathing. Shearn (1961:457) stated, "It seems unlikely that a particular bodily system is completely free from the influence of other bodily systems."

Miller and Carmona (1967) undertook several experiments with reference to the salivation of dogs during an instrumental training period. One group of dogs was rewarded with water for salivating; the other group was rewarded for not salivating. The results showed that the response of salivation (which is controlled autonomically) can be modified by an instrumental training procedure--those rewarded for salivating showed progressive increases in salivation and those rewarded for not salivating showed progressive decreases in salivation.

Jay Trowill (1967) studied instrumental conditioning of the heart rate in the rat. Although Miller and Carmona (1967) had attempted to eliminate the possibility of skeletal muscle interference by means of a partial correlation of the data, Trowill felt a more conclusive control of muscular reaction was necessary. By means of the drug, curare, which "selectively blocks the motor end plates of skeletal muscles without eliminating the consciousness in human subjects or the neural control of visceral responses" (Miller, 1969:435), rats were rewarded by electrical stimulation of the brain for a fast or slow heart rate. Those rats rewarded for a slow heart rate showed a statistically reliable decrease, and those rats rewarded for a fast heart rate showed a statistically reliable increase.

Using a "shaping" technique--progressively shifting rats to a more difficult criterion after they had learned to meet an easier one," Miller and DiCara (1967) rewarded rats, paralyzed by curare and respired artificially, by electrical stimulation of the medial forebrain, for increasing or decreasing their heart rates. Twenty-one of the twenty-three rats showed highly reliable changes.

DiCara and Miller (1968a) investigated heart rate changes in rats conditioned instrumentally to avoid shock. All changes in heart rate--increases for the fast group and decreases for the slow group--were significant at the .001 level of significance.

Miller and Banuazizi (1968) investigated the specificity of visceral learning in rats that were paralyzed by curare and maintained by artificial respiration, and rewarded by electrical stimulation of the brain. Intestinal contractions and heart rates were recorded for all rats, but half were rewarded for changes in intestinal contractions and half were rewarded for changes in heart rate. The intestinal contraction group was divided further into an increase in contractions group and a decrease in contractions group, and the heart rate group was divided into an increase in heart rate group and into a decrease in heart rate group. The results showed that those rats rewarded for a decrease in intestinal contraction decreased significantly and those rewarded for an increase in intestinal contraction increased significantly, but neither group showed a significant change in heart rate. Those rats rewarded for an increase in heart rate increased significantly, and those rewarded for a decrease in heart rate decreased significantly, but there was no significant change in intestinal contraction.

Miller and DiCara (1968) attempted to change the rate of urine formation in the curarized rat by electrical stimulation of the brain. When lengthened periods between times of urine-drop formation were rewarded, the rats showed decreases in the rate of urine formation; when shortened periods were rewarded, the rats showed increases in the rate or urine formation ($p < .001$).

The thesis that learning can occur when changes in systolic blood pressure are reinforced specifically was examined by DiCara and Miller (1968c). Curarized rats either increased or decreased their systolic blood pressure and were rewarded by escape and/or avoidance of electrical shock. Without exception, all rats changed their blood pressure in the rewarded direction.

Instrumental Conditioning in Human Beings

One of the first reports of operant conditioning of heart rate in human beings was published by Shearn (1962). He attempted to "manipulate heart rate through response-contingent techniques." The human subjects were conditioned operantly to accelerate their heart rates to delay shock pulses.

Twelve male subjects enrolled in Indiana University during 1960 were selected for participation in five daily sessions. The subjects were divided into two groups of matched pairs, an experimental group composed of six subjects, and a yoked-control group composed of the remaining subjects matched to the experimental subjects. This division was necessary because heart rate would naturally increase with shock and the associated stimuli; therefore the effects of operant conditioning had to be separated--this accomplished by yoked-control group. The experimental subjects were exposed to shock treatments contingent upon their ability to accelerate their heart rate; the control subjects received the same number of shocks at the interval of the experimental subjects to whom they were matched. The control subjects were actually under a classical conditioning experience, while the experimental group was conditioned operantly. The treatments of the two groups were different only in the fact that shock was contingent to criterion heart rate acceleration in the experimental group, while it was not in the control group. Each group was divided further according to the length of the interval between the regular intervals. Three subjects in the experimental group and their three matched subjects in the control group experienced a shock schedule of a sixty-second interval, while the remaining subjects experienced a twenty-second shock interval. Held constant was the total number of possible shocks--the group experiencing the sixty-second interval was tested each day for sixty minutes; the group experiencing the twenty-second shock interval was tested for forty minutes each day, and shocks were given only fifty per cent of the time.

A modified Sidman-avoidance schedule (Sidman, 1953) was used in the experiment. In this procedure, as developed by Sidman, at regular intervals shock impulses are delivered to the animal unless a lever is pressed to delay the shock. In the modification of Shearn, five heart beats within a criterion interval had to occur to delay the shock impulses. Five per cent of the average time required for five beats was subtracted from this average time during the preceding few minutes to establish the criterion. An illuminated reset timer was available as feedback for the subjects--the timer timed the regular interval between shocks, and would reset and delay shock whenever the heart rate accelerations reached the criterion level. A loud speaker made the heart beat audible to the subject.

Of the six experimental subjects, five exhibited an increase in the percentage of accelerations throughout the five daily sessions. A decrease in percentage of temporary accelerations across the sessions was shown by all of the control subjects. By means of the Mann-Whitney U Test, a significant difference was found between the change in performance of the two groups at the .03 level of significance.

The subjects experiencing the twenty-second shock interval--both experimental and control--exhibited many more criterion accelerations than did the group upon the sixty-second shock interval. Not one subject upon the sixty-second interval showed as high a percentage of accelerations reaching criterion level as did the subjects upon the twenty-second interval. With reference to the schedules of shock impulses, overall heart rate was affected markedly by the difference in intervals--but not by the different groups. A significantly greater decrement in heart rate was shown by both the experimental and control subjects in the twenty-second shock interval group than was shown by the subjects in the group experiencing the longer interval of shocks at the .005 level of significance. Shearn states that there was a steeper downward trend in heart rate and also a greater tendency for short-term increases in heart rate of criterion magnitude for the subjects upon the twenty-second interval shock schedule than for subjects upon the sixty-second shock schedule.

Shearn reported also no reduction in the number of shocks from the first day (mean = 13.3 shocks) to the last day (mean = 13.9 shocks). In most experiments using the Sidman procedure, the number of shocks tended to decrease with each session. Shearn recommended an experiment of longer duration to determine the reason for this effect.

No attempt was made to control respiration, although it was recorded. Immediately preceding and during heart rate accelerations which reached criterion level, respiration amplitude was greater than when heart rate accelerations did not reach criterion level, significant for combined treatments at the .02 level of significance. With reference to the group which was conditioned operantly and the yoked-control group, there was no significant difference concerning amplitude of respiration.

Just before the first criterion acceleration of heart rate, the persons subjected to operant treatment showed a higher respiration rate than did the control group, significant at the .05 level. Although there were important differences in heart rate between the groups who were subjected to shock at sixty-second intervals and those who were subjected to shock at twenty-second intervals, respiration rate showed no significant differences between these groups.

The subjects in the experimental group accelerated their heart rates a greater number of times throughout five daily practice sessions than did the yoked-control subjects who received shock upon a non-contingent basis. The shorter interval between shocks--twenty-seconds--produced more accelerations in heart rate, but also a faster adaptation was shown.

Hnatiow and Lang (1965) completed a study in which they attempted to bring the variability of heart rate under experimental control of human subjects. The general purpose of the experiment was to assess the degree of stability of the heart rate attained when the experimental subjects received immediate feedback concerning the stability of their heart rate, as opposed to the control group which received no auxiliary information. Forty male students in good physical health from the University of Pittsburgh served as subjects in partial fulfillment of an introductory psychology research requirement. Twenty of the subjects were selected randomly to form the experimental group which was told to "keep their heart rate as steady as possible during the experiment." The remainder of the subjects formed the control group and were told to "keep their bodily processes at a steady level during the experiment."

An opaque projector presented the display of heart rate to the subject. The visual display apparatus consisted of a pointer whose lateral movements were synchronized with a Fels cardiotachometer. The background of the display was white with a red stripe in the center of the field. On either side of the red stripe were blue stripes--the width of the stripes, red and blue, was equated to two heart beats per minute. The apparatus was adjusted for each subject so that the center of the red stripe represented his average heart rate.

A darkened, sound-proofed and electrically shielded room was utilized for the experiment. While seated in a reclining lounge chair, electrodes were attached to either side of the rib cage to measure electrocardiographic impulses. A bellows was fixed around the chest of the subject to measure respiration.

In addition to the attempt to maintain heart rate stability, the experimental group was instructed also to observe carefully the visual display and to keep the pointer in the red portion of the field for assistance in the completion of the task. Although the control subjects received visual feedback from the display, they were not told that the display was representative of their heart rate. This group was instructed to monitor the movements of the pointer, with the knowledge that they should attempt to maintain their bodily processes at a steady level. The pointer was not synchronized with the heart rate of the control subject--its movements merely simulated cardiac output. The visual display was observed for all subjects for a five minute period initially, followed by a sixteen minute period of adaptation--followed by two more five minute trials with seven minute intervals between trials. For nondisplay periods, the screen was illuminated by a green light--no visual feedback of heart rate.

Time on target and the standard deviation of heart rate were the principal measurements in this experiment, although average heart rate and respiration were also measured. The target area consisted of the pointer being either on or in between the blue stripes. Total time on the target was recorded for each five minute period of display and for the first five minutes of the nondisplay periods.

Analysis of variance of the time on target scores for the twenty subjects in the experimental group revealed a difference between display periods and nondisplay periods at the .01 level of significance. The standard deviations of the heart rates of the experimental group were lower for the display trials as compared with their nondisplay trials or with the scores of the control group. Analysis of variance again confirmed a significant interaction between display information and trials at the .05 level of significance. Although both the experimental group and the control group exhibited a heart rate that was significantly slower during the display periods, there was no difference between the two groups. By means of a Pearson Product Moment Correlation, no relationship was found with reference to change in the variability of heart rate and of respiration.

Hnatiow and Lang concluded that the ability to reduce heart rate variability can be learned and the results achieved without aversive reinforcement. Since there was no significant correlation between cycle of respiration and cardiac variability, the experiment did not support the idea that learned control of heart rate affects greatly a change in respiration.

Engel and Hansen (1966) attempted to determine if the slowing of heart rate could be conditioned operantly.

The subjects were not aware that heart rate slowing was the response being studied and reinforced.

Fifteen male college students were selected for participation in the experiment--ten experimental subjects "for whom response and reinforcement were contiguously associated" and five yoked-control subjects "for whom response and reinforcement were dissociated." Although the subjects were unaware of the response to be reinforced, they were told that it was not related to breathing, and to therefore breathe normally. A correct response turned on a light and a clock--the light was the cue for a correct response. The clock accumulated time of correct responses for the subjects who were paid one-half cent per second of correct response time.

Three phases constituted the six experimental sessions for each subject. Phase 1 was an adaptation period which enabled the subject to stabilize his resting heart rate for thirty minutes without benefit of the clock or the light; Phase 2 established the operant-level heart rate of each subject for five to eight minutes; Phase 3 was a training period of twenty-five minutes during which time the light and clock were under the control of the subject.

During the first two experimental sessions an operant-level heart rate was found that would keep the light on for each subject eighty per cent of the time--a high rate of reinforcement and analogous to "shaping techniques" used in other operant conditioning studies.

Throughout the last four experimental sessions the operant-level heart rate was set so that the heart rate of the subjects would turn the light on fifty per cent of the time. These sessions were the "critical" ones, and performance only during session three through session six constituted the periods of learning.

Three measures of learning were used: (1) change in percentage time of heart rate below trigger level (ten samples each twenty-five seconds during operant period and forty samples each twenty-five seconds during the training period); (2) change in heart rate (measured by a sample of 100 beats); and (3) change in number of beats less than or equal to the operant mean heart rate (measured by a sample of 100 beats). To determine if learning occurred, separate means and standard deviations were computed for sessions three through six and combined for a single significance test. A _t_ test was used to test the difference in change in percentage time and the change in heart rate.

Five subjects met all three criteria for learning--increase in percentage times light on, decreases in average heart rate, and shifts in frequency distributions. Two other subjects showed learning in only one criterion measure, and the three remaining experimental subjects exhibited poorer performances than those subjects who met at least one criterion of learning.

Four concluding statements were drawn up by the authors:

1. Some normal Ss can be taught to slow their HR by means of an operant conditioning procedure.
2. Ss seem to learn this response better when they do not infer correctly what response they are controlling.
3. The effect does not seem to be mediated through changes in breathing.
4. Reinforcement, per se, is not adequate to lower HR (Engel and Hansen, 1966:186).

It is interesting to note that of the five learners, none inferred that slowing the heart rate was the response to be reinforced, while four of the five nonlearners inferred the correct response.

Brener and Hothersall (1966) undertook a study to determine if autonomic behavior of the heart may be subject to voluntary control when the subject is given the appropriate response feedback. Two female and three male university students were selected from a group of volunteers to participate in the study. The subjects had no recent history of cardiac, respiratory, or psychological disorder, and they were paid $1.50 per hour. No groups were formed--each subject was treated individually.

The apparatus is described by the authors:

> The cardiotachometer used to record heart rates converts the EKG wave form to a standard square-wave pulse and records the intervals between successive heart beats (interheart beat IBI distribution) on a bank of 30 electromagnetic counters. A heart rate analysis circuit was used to classify each IBI in terms of a prespecified criterion. This criterion was set separately for each subject at the mode of his basal IBI distribution. Each IBI was then classified according to whether it was longer or shorter than this criterion.

> When the experimental contingencies were in force, the subject was presented with a low frequency tone on the emission of each long IBI and a high frequency tone on the emission of each short IBI. Those tones represented differential feedback of heart rate performance: the duration of each tone was 100 msec. Respiration was recorded on a San'ei Physiograph (Brener and Hothersall, 1966:24).

Electrodes were attached to both ankles and to the right wrist and a strain gauge was attached to the chest to record respiration as the subject was reclining in a soundproofed cubicle adjoining the control room. When the experimenter left the room a green light would come on for approximately a minute (the time it took for the subject to emit fifty IBI's), followed by thirty seconds of darkness. A red lamp was then lighted. Only when one of these lamps was lighted would the subject hear a succession of high and low frequency tones through headphones. The subjects knew these tones were contingent upon some variable of their internal behavior, but they did not know heart rate was the desired response. The subject was to attempt to produce only high tones and inhibit low tones when the green light was on; the subject was to produce only low tones and to inhibit high tones when the red light was on. Control of tones was to be through "mental processes" only--no bodily movements were to be used. Alternating green and red periods, four of each, composed an experimental period.

With reference to the final green and red periods, it is clear that all subjects emitted higher heart rates in the final green period than in the final red period, significant at the .01 level. More erratic respiration patterns were found during the green period than during the red period. No subject discovered that the tones were controlled by heart rate.

The authors concluded that subjects learn rapidly to control their heart rates "under conditions of augmented sensory feedback." They also reported that their findings

> . . . are taken as support for a theory which postulates that the principal discriminator between so-called voluntary and involuntary behaviors is the availability of specific feedback from the muscle systems in question (Brener and Hothersall, 1966:27).

Frazier (1966) conducted a study pertaining to avoidance conditioning of heart rate in humans. The author attempted to use operant conditioning to acquire and exercise experimental or environmental control over heart rate.

Male undergraduate students were employed to serve as experimental subjects. Criteria for the selection of subjects were that they had no recent illnesses or injuries, no excessive emotionality, and no heart rate exceeding 180 beats per minute during experimental sessions.

Heart rate of the subjects was conditioned and evaluated within a single trial of 120 minutes. During the first sixty minutes the availability of the electrical shock punishment was signaled by the discriminative stimulus. During the last sixty minutes, the discriminative stimulus was presented alone to cause the desired response patterns.

The visual discriminative stimulus was presented in ten twenty-minute continuous durations, alternating with control periods in which punishment was not available. During the discriminative stimulus periods:

> . . . an electrical shock was dispensed to the left leg of the S after each minute in which the total number of beats decreased below the previous minute's total. If HR failed to decrease, punishment was withheld. Punishment, but not the visual stimulus, depended upon HR decrement.
>
> After a few training epochs, alternating with base-line epochs, the visual stimulus was successively presented and removed for various durations which depended upon the specific trial goal. In some cases, further biological avoidance contingencies were established between the discriminative stimulus and HR changes (Frazier, 1966:189).

The subjects, who were not aware that heart rate was the response upon which punishment was contingent, were given an instrument panel-monitoring task to perform during the duration of the session in an attempt to condition without awareness. After the two hour experimental sessions, all subjects showed heart rate control, and were able to maintain this control over continuous forty-minute periods. Frazier concludes with this statement: "These findings demonstrate that punishment avoidance contingencies can be used to impose effective control over cardiovascular functioning." (Frazier, 1966:188)

Engel and Chism (1967) undertook a study to investigate operant conditioning of the speeding of the heart rate. This study was the second in a series of studies with reference to heart rate conditioning by operant techniques--the first study being reported earlier (Engel and Hansen, 1966).

Ten male college students were selected to participate in the study--five experimental subjects "for whom response and reinforcement were contiguously associated;" and five yoked-control subjects "for whom response and reinforcement were dissociated." (Engel and Chism, 1966:418) The subjects were aware that they were to be conditioned, but they were not told that heart rate was the response to be rewarded. A correct response would turn on a light and a clock. The clock accumulated time of correct response, for which the subjects were paid one-half cent per second.

Three phases constituted each of the six experimental sessions: Phase 1 was an adaptation period of forty minutes to allow the heart rate of the subject to stabilize; Phase 2 consisted of a period of five to eight minutes during which a heart rate level was established above which the subject would be reinforced; Phase 3 was a training period of twenty-five minutes during which the light and clock were under the control of the subject. The light and clock were inoperable during the first two phases. The procedures were identical to those of the earlier study (Engel and Hansen, 1966) except that the subjects in the second study were rewarded for speeding their heart rates.

Since all subjects learned to speed their heart rates, Engel and Chism drew three conclusions: the speeding of heart rate is easier to learn than the slowing of heart rate; yoked-control subjects respond to a learning situation with a pattern of response that includes the speeding of heart rate; and the techniques for speeding heart rate vary greatly from subject to subject.

Levene, Engel, and Pearson (1968) attempted to operantly condition human subjects to increase and decrease cyclically their heart rate. A differential operant conditioning procedure was utilized. Five female college students were selected to participate in the study. They were unaware that they were being taught to control their heart rate.

The total number of two-hour experimental sessions ranged from six to ten on consecutive week-days, depending upon how rapidly the subject met the criterion of learning. In a darkened, sound-proofed room adjoining the experimenter's room, the subjects were semireclined upon a bed with a strain gauge placed around the chest of the subject to record breathing. To monitor cardiac potential, electrodes were placed upon the arms and chest of the subject.

Three lights and a clock which was controlled electronically were placed within the visibility of the subject at the foot of the bed. Serving as discriminative cues were the upper and lower lights--the upper light signaling for increased heart rate and the lower light signaling for a decreased heart rate. The immediate reinforcement for a correct response consisted of the clock and the middle red light.

The subjects were told that they were to be conditioned, but they were not informed what response was to be conditioned. After thirty minutes of rest, either the upper or the lower light would come on for approximately twenty-five minutes. While that light was on, the subjects were in control of the middle red light. When they made the correct response (either increasing or decreasing heart rate) the red light would come on and the clock would accumulate the time of the correct response. The subjects were paid at the rate of one-fourth cent per second for time upon the clock.

The subjects were conditioned to slow and to speed the heart rate until they could keep the reinforcement light on for more than fifty per cent of the time. It was found that it was a more difficult task to increase and decrease the heart rate cyclically. Although all subjects mastered the task upon at least one occasion, only two subjects performed with consistency. The authors of the article stated, "It seems that the slowing response is more difficult and takes more time to master" (Levene, Engel, and Pearson, 1968: 839).

It was concluded that with the appropriate reinforcement schedule, subjects could gain minute-to-minute control of heart rate. When a speeding response was required, the mean heart rate was significantly greater ($p < .01$) than the mean heart rate when a slowing response was required.

Mize (1970) completed a study to determine if heart rate slowing could be instrumentally conditioned under exercise stress. She found that eleven of the fifteen experimental subjects exposed to instrumental conditioning over a two week period did meet the criterion for learning to lower their heart rate while in a resting position. The total heart rate change, determined by a summation of the heart rate differences upon the three levels of exercise stress, was not significantly different between the experimental subjects who met the criterion for learning and received instrumental conditioning and the control subjects who received no conditioning. However, the cumulative effect of heart rate change of all subjects in the experimental group, upon a summation of the heart rate differences upon the three designated levels of exercise stress taken pre-training and post-training, was significantly different for the experimental subjects as compared with the control subjects. The significant difference was believed to be related to the length of practice provided for the slower learners; heart rate lowering for the experimental group was not significantly different from the control group at any of the three specific levels of exercise stress measured. However, when the data were subjected to further statistical treatment, there was a significant mean difference between the eleven subjects in the experimental group who met the criterion for learning to lower their heart rate in a resting position and the control subjects to whom they were equated upon the bicycle ergometer test of exercise stress at heart level 100-120 beats per minute; the data collected for this study failed to provide sufficient information for the investigator to reject the hypothesis. As a result of the statistical findings, it was concluded that instrumental conditioning during the resting state appears to facilitate heart rate lowering in the exercise stress situation measured, but not to a statistically significant degree.

## Summary

For many years Neal E. Miller has held the idea that there is only one kind of learning--this belief contrary to the traditional concept of classical or involuntary conditioning and instrumental or voluntary conditioning. These two types of conditioning had been associated similarly with the muscular responses: voluntary skeletal responses and instrumental conditioning, and involuntary visceral responses and classical conditioning. To uphold his belief, Miller attempted to show that so-called "involuntary" visceral responses could be conditioned by traditional instrumental methods.

In a study which brought the problem to the attention of the psychophysiological profession, Miller and Carmona found that dogs could be conditioned instrumentally to salivate. A more stringent method of eliminating skeletal muscle interference was needed, so the investigators began using curare, a drug which blocks acetylcholine, the chemical transmitter by which cerebrospinal nerve impulses are delivered to skeletal muscles, but does not interfere with consciousness or autonomic responses. Trowill found that curarized rats rewarded for a slow heart rate decreased their heart rates significantly; those rewarded for a fast heart rate increased significantly. Highly reliable changes in the heart rate of rats were reported by Miller and DiCara.

Other studies reported successful operant conditioning techniques in increasing and decreasing heart rate to avoid shock; in changes in intestinal contraction and heart rate; in urine formation; and in systolic blood pressure.

Shearn published one of the first reports of conditioning human heart rate operantly. He found that experimental subjects were able to accelerate their heart rates to delay shock pulses. Hnatiow and Lang found that aversive reinforcement was unnecessary, and conditioned subjects to decrease heart rate variability without this aversive reinforcement.

Engel took part in three studies with reference to conditioning of heart rate by means of operant procedures:

five of ten experimental subjects were taught to slow their heart rates; all experimental subjects learned to speed their heart rates; and subjects gained minute-to-minute control of heart rate when taught to increase and decrease cyclically.

Brener and Hothersall showed that under conditions of augmented sensory feedback, subjects learn rapidly to control their heart rates. Using operant procedures to condition subjects to exercise voluntary control over heart rate, Frazier reported that punishment avoidance contingencies were effective in imposing control over heart rate.

Mize investigated the possibility that heart rate slowing could be conditioned instrumentally under exercise stress. She concluded that instrumental conditioning during the resting state appears to facilitate heart rate lowering in the exercise stress situation measured, but not to a statistically significant degree.

Chapter III will present the procedures followed in the development of the study.

## CHAPTER III

## PROCEDURES FOLLOWED IN THE DEVELOPMENT OF THE STUDY

The present investigation entailed a study of thirty-five students divided into one control and two experimental groups who were enrolled in Eastern Illinois University in Charleston, Illinois, to determine if heart rate lowering during exercise stress could be instrumentally conditioned. In this chapter, methods of collecting data, and procedures followed in the development of the study will be discussed. The procedures will be reported under these headings: preliminary procedures, selection of subjects, selection and orientation of persons to aid in the administration and scoring of tests, criteria for the selection of the instruments, selection and description of the instruments, procedures followed in the collection of the data, organization and treatment of the data collected, and preparation of the final written report.

### Preliminary Procedures

Prior to the actual collection of data, a series of preliminary procedures was necessary. These procedures included surveying, studying, and assimilating all available literature pertinent to the study; securing permission from the Dean of the School of Health, Physical Education, and Recreation at Eastern Illinois University to conduct the proposed study during the summer quarter of the academic year of 1970-1971; developing and presenting a tentative outline of the study at a Graduate Seminar of the College of Health, Physical Education, and Recreation at the Texas Woman's University in Denton, Texas; revising the outline in accordance with the suggestions offered by members of the dissertation committee, and filing a prospectus of the approved study in the Office of the Dean of Graduate Studies.

## Selection of Subjects

Two criteria were established for use in the selection of subjects: each subject should be female and each should be enrolled in Eastern Illinois University in Charleston, Illinois, during the summer quarter of 1970-1971. The first thirty-five volunteers were selected to participate in the study

## Selection and Orientation of Persons to Aid in the Administration and Scoring of Tests

The investigator selected an undergraduate student in the School of Health, Physical Education, and Recreation of Eastern Illinois University in Charlestion, Illinois, to serve as a laboratory assistant. This student participated in several orientation and practice sessions to achieve consistency and skill in the placement of electrodes and in the operation of the equipment--the treadmill and the tachometer.

## Criteria for the Selection of the Instruments

Prior to the selection of the instruments, criteria for the selection were established. A survey of authoritative sources--Willgoose (1961:24), Mathews (1969:24-28), Haskins (1971:7-8), and Sheehan (1971:47-54)--indicated that the instruments should meet the following minimum criteria: validity, reliability, objectivity, and administrative feasibility.

## Selection and Description of the Instruments

The inherent nature of the Narco Bio-Systems Biotachometer, BT-1200, precludes that the instruments were reliable and valid for measuring beat-by-beat heart rate with the subjects in a resting position and during exercise upon the treadmill. A built-in calibration device upon the Narco Bio-Systems Physiograph Four insures an objective measurement for each subject. All pieces of equipment were available at the Human Performance Laboratory of the School of Health, Physical Education, and Recreation at Eastern Illinois University, the Human Performance Laboratory of the Texas Woman's University, or were made available through the Narco Bio-Systems, Incorporated, Houston, Texas. The treadmill was selected because of the advantage in using a skill with which everyone is familiar (walking or jogging). Furthermore, it seems to bring about a slightly better involvement of large muscle masses than any other device since the arms and shoulders can and do enter into the activity (deVries, 1966:146). Electrodes were placed upon either side of the rib cage, and a ground electrode was placed just below the xiphoid process after consultation with a Narco Bio-Systems representative.

## Procedures Followed in the Collection of Data

Prior to the experimental period, a practice session was conducted to familiarize all subjects with the technique of treadmill running. The investigator assummed that the fear of the treadmill alone would accelerate the heart rate, and the pretest data would be invalidated by this apprehension. The practice sessions consisted of two ten-minute trials upon two consecutive days. In addition, before the pretest, all subjects were tested upon the treadmill to determine the work load for each individual which would allow the heart rate to stabilize for at least one minute, plus or minus five heart beats within each work load level. The levels were defined as the load necessary to stabilize the heart rate at 100-120 beats per minute, at 120-140 beats per minute, at 140-160 beats per minute, and at 160-180 beats per minute. The loads imposed upon each subject were determined through a trial and error process. These loads proved to be inaccurate during the actual testing because of the differences encountered in the resting heart rate between sessions.

After the practice sessions had been completed and the work loads determined for each individual, the subjects were randomly distributed into three groups, two experimental and one control, equated for the resting heart rate of the subjects. One group of fifteen subjects took part in the experimental sessions consisting of instrumental learning of heart rate lowering in the resting state--this group was designated as Experimental Group I. One group of nine subjects was allowed to practice the volitional control of heart rate lowering in the same manner as the first experimental group but was not provided any immediate feedback or other information that would allow them to know the extent of their practice control until after the experimental period, when the subjects were told if they had reached the criterion of learning--this group was designated as Experimental Group II. The Control Group of eleven subjects was tested prior to the experimental period and again at the end, but no practice took place between tests. The total number of subjects was thirty-five.

Each experimental subject in both experimental groups met individually, each day for ten days for a thirty minute conditioning session. The subjects were provided a ten minute period at the beginning of each experimental session to establish a base level heart rate in the resting position. Ten minutes was chosen as the base level upon the basis of a previous investigation (Mize, 1970). A resting heart rate was established from a sitting position for each subject at the beginning of each experimental session. This rate was determined by measuring the last ten heart beats in each of the last three minutes of the stabilization period that lasted ten minutes prior to all testing (Brooke, Hamley, and Thomason, 1970). A mean heart rate was established each day upon the basis of these selected heart beats. A ten per cent decrement of the mean resting heart rate of the subject upon command was considered as the level of acceptability for heart rate lowering while sitting and while under exercise stress. The designated decrement was decided upon after careful consideration of previous research and preliminary investigation. After receiving the designated conditioned stimulus during the resting state, heart rate lowering was measured by the lowest ten consecutive beats in the thirty second stimulus-response period and then extrapolated to one minute.

A conditioned stimulus for heart rate lowering (the word "lower" given by the investigator) was presented to the subject four times each experimental period. A thirty second interval, after the verbal command, was established through preliminary investigation as adequate time for heart rate lowering to occur. The mean heart rate per minute as determined by the ten heart beats immediately preceding the conditioned stimulus was measured and extrapolated to one minute before each trial per experimental session, and this mean heart rate was the value from which the ten per cent decrement of the resting heart rate measured at the beginning of the session was taken. The lowest ten consecutive beats per minute during the thirty second post stimulus period were measured to determine ability in heart rate lowering. Each stimulus-response pattern or trial was followed by a two minute relaxation period before the next trial. Each experimental subject was required to lower her heart rate significantly--ten per cent of the daily resting heart rate--three of the four trials presented each day, for two consecutive days to meet the criterion established for learning in this study. Each subject continued the conditioning period for the full ten days even if they met the criterion level sooner. Learning times and curves are presented in Chapter IV.

A continual read-out or visual display of the beat-by-beat heart rate of the subject during each experimental session was monitored upon a Narco Bio-Systems, Incorporated, Biotachometer, BT-1200, as immediate feedback and reinforcement of the response. Experimental Group I was allowed to watch the visual display of their heart rate as feedback in order that they would know how they were progressing from day to day with reference to different techniques of heart rate lowering. Experimental Group II was attached to the tachometer, but were not allowed to watch the visual display--they were not provided any immediate feedback or reinforcement until after the experimental period when the subjects were told if they had reached the criterion of learning. The information was recorded for both groups.

The conditioned stimulus for heart rate lowering during exercise stress was presented to each subject at each predetermined work load level. The levels are defined as the load necessary to stabilize the heart rate at 100-120 beats per minute, at 120-140 beats per minute, at 140-160 beats per minute, and at 160-180 beats per minute. The designated levels of heart rate were assigned randomly for each subject for the pretest and for both post-tests. At least an hour elapsed between a test at each level to allow the heart rate to return to its resting rate before a test was administered at another level. This was to prevent accumulated effects of stress, and the randomization was to control for carry-over effects of learning at each level. The treadmill was selected to induce exercise stress because it involves a fundamental skill, that requires little acclimitization to insure validity and reliability. The mean heart rate per minute determined by ten heart beats immediately preceding the conditioned stimulus at each level was measured, and this mean heart rate was the value from which the ten per cent decrement of the resting heart rate measured at the beginning of the session was taken. Again, the lowest ten consecutive beats per minute during the thirty second post stimulus period were measured and extrapolated to one minute to determine ability in heart rate lowering.

Data sheets were constructed to record the heart rate of the subject during the experimental sessions. A cumulative record of the conditioned response under exercise stress was compiled upon the established data sheets located in the Appendix of the study.

## Organization and Treatment of the Data Collected

The procedures which follow include those related to studying the statistical evidence collected during the pretest, post-tests, and the experimental sessions, selecting the statistical techniques, and treating the data. The data were tabulated with respect to evidence of heart rate lowering as measured by the biotachometer.

The purpose of the study as set forth in the hypothesis was reviewed. To test the difference in the ability to lower heart rate during exercise stress between the three groups, analysis of variance was utilized--a three-way analysis of variance with repeated measures upon two factors

(Bruning and Kintz, 1968: 72-83). The .05 level of significance was selected by the investigator as requisite to the rejection of the null hypothesis. Duncan's Multiple Range Test was used to test the differences between the thirty-six means yielded by the three groups at four levels upon three tests (Bruning and Kintz, 1968: 115-117). The .01 level was chosen as the level of significance with reference to the Duncan's Multiple Range Test.

## Procedures Related to Writing the Final Report

Upon the completion of the statistical treatment of the data, the investigator summarized the report, stated a conclusion to the study, and discussed the implications of the study. The final procedures included making recommendations for further studies, compiling a bibliography, and developing an appendix.

## Summary

The procedures followed in the development of the study were outlined in this chapter. These procedures included those which were related to methods of collecting data, and those which were preliminary to the collection of the data. Preliminary procedures involved the selection of the instruments.

The instrument selected for use in the study was the Narco Bio-Systems Biotachometer, BT-1200, to monitor a continual beat-by-beat heart rate. The treadmill was chosen to induce exercise stress. Subjects for the study were thirty-five students enrolled in Eastern Illinois University in Charleston, Illinois, during the summer quarter of 1970-1971, who were divided into two experimental groups and one control group. Experimental Group I took part in the experimental sessions consisting of instrumental learning of heart rate lowering in the resting state using a visual display of their beat-by-beat heart rate as feedback and immediate reinforcement; Experimental Group II was allowed to practice the volitional control of heart rate lowering in the same manner as the first experimental group but was not provided immediate feedback or other reinforcement until after the experimental period when the subjects were told if they had reached the criterion of learning; the Control Group was tested prior to the experimental period and again at the end, but no practice took place between tests.

Preliminary to the experimental period, a practice session was conducted in which all subjects were familiarized with the technique of treadmill walking. Another practice session was held to establish approximate work loads for each individual subject at each of the four levels--100-120 beats per minute, 120-140 beats per minute, 140-160 beats per minute, and 160-180 beats per minute. The work load was the amount of work upon the treadmill which would allow the subject to stabilize her heart rate plus or minus five heart beats within the level for at least one minute duration.

After the practice sessions had been completed and the work loads determined for each individual, the subjects were randomly distributed into three groups, two experimental and one control, equated for the resting heart rate of the subjects. A pretest was then given to all subjects in which they were asked to lower their heart rates at a given signal after they had reached the designated level, which was assigned randomly. The experimental groups then were exposed to ten days of conditioning, thirty minutes a day, in which they attempted to lower their heart rates in a sitting position for four trials per day. After the conditioning period was over, both the Control Group and the experimental groups were again given the test of heart rate lowering during exercise stress as previously described. This post-test was administered twice upon two consecutive days to provide a more reliable score for heart rate lowering during exercise stress.

An analysis of variance technique was selected to test the significance of the differences between the three groups in the ability to control the heart rate under exercise stress. The .05 level of significance was accepted as the point for the rejection of the null hypothesis. Duncan's Multiple Range Test was utilized to test the differences between the thirty-six means yielded by the three groups at four levels upon three tests. The assigned level of significance for Duncan's Multiple Range Test was the .01 level. The final procedures included those related to summarizing and writing the final report.

Chapter IV is the presentation and interpretation of the findings.

# CHAPTER IV

## PRESENTATION AND INTERPRETATION OF THE FINDINGS

The purpose of the investigation was to determine in heart rate lowering could be instrumentally conditioned during exercise stress. It was hypothesized that there would be no significant difference in heart rate lowering of those subjects in Experimental Group I who received instrumental conditioning with immediate feedback, in Experimental Group II who received instrumental conditioning with delayed feedback, and in the Control Group who received no conditioning. The subjects, who volunteered for the experiment, were assigned randomly to one of three groups prior to the pretest period.

### Comparisons of Mean Resting Heart Rates for the Three Groups

After the subjects were assigned randomly to one of the three groups, the mean resting heart rate of each subject was subjected to statistical treatment to examine the homogeneity of the groups prior to testing. The mean resting heart rate for each subject was determined by taking the average of her resting heart rate prior to the two practice periods. The mean resting heart rate for Experimental Group I was 86.33 beats per minute and the standard deviation was 11.61 beats per minute; the mean resting heart rate for Experimental Group II was 84.33 beats per minute and the standard deviation was 8.49 beats per minute; the mean resting heart rate for the Control Group was 85.09 beats per minute and the standard deviation was 13.55 beats per minute. The findings from the application of a one-way analysis of variance to the resting heart rates are presented in Table 1 and show that the groups were equated.

TABLE 1

SUMMARY TABLE FOR ANALYSIS OF VARIANCE OF MEAN RESTING HEART RATES

| Source | SS | df | ms | F |
|---|---|---|---|---|
| Between Groups | 24.3290 | 2 | 12.1645 | 0.0905 |
| Within Groups | 4298.2425 | 32 | 143.3200 | |
| Total | 4322.5715 | 34 | | |

$F_{(2,32)}(.05) = 3.32$

The application of the one-way analysis of variance resulted in an *F* ratio of 0.0905. In order to be significant at the .05 level, an *F* ratio of 3.32 had to be obtained. It was then concluded that the three groups were homogeneous with respect to mean resting heart rate obtained prior to the pretest period.

A Description of the Groups upon the Pretest

The conditioned stimulus for heart rate lowering (the word "lower" given by the investigator) during exercise stress was presented to each subject at each predetermined work load level during the pretest. The levels were defined as the load necessary to stabilize the heart rate at 100-120 beats per minute, at 120-140 beats per minute, at 140-160 beats per minute, and at 160-180 beats per minute. The designated levels of heart rate were randomly assigned for each subject for the pretest. At least an hour elapsed between each test at each level to allow the heart rate to return to its resting rate before a test was administered at another level. Descriptive data for the pretest are shown in Table 2.

TABLE 2

MEAN CHANGE SCORES FOR THE THREE GROUPS UPON THE PRETEST (IN BEATS PER MINUTE)

| Group | Level 100-120 | Level 120-140 | Level 140-160 | Level 160-180 |
|---|---|---|---|---|
| Experimental Group I | -3.6380 | +0.2247 | -2.8873 | +2.6013 |
| Experimental Group II | -1.6967 | -2.0533 | -4.1278 | +1.8478 |
| Control Group | -1.3855 | +1.7945 | -2.5582 | -1.1809 |

The mean resting heart rates, measured immediately prior to the pretest were 85.46 beats per minute for Experimental Group I, 84.04 beats per minute for Experimental

Group II, and 86.51 beats per minute for the Control Group. Therefore, to meet the ten per cent decrement of the mean resting heart rate established as the criterion for significant lowering of the heart rate (Chapter III, page 41), Experimental Group I would have had to lower 8.55 beats per minute, Experimental Group II would have had to lower 8.40 beats per minute, and the Control Group would have had to lower 8.65 beats per minute. An inspection of Table 2 shows that although each group lowered their heart rates when tested with the heart rate between 100-120 beats per minute (as evidenced by negative values), none approached the established ten per cent decrement. During the level where the heart rate was between 120-140 beats per minute, both Experimental Group I and the Control Group actually raised their mean heart rates after the conditioned stimulus (as evidenced by positive values), whereas the mean value of Experimental Group II points out that the subjects lowered their heart rates. All groups lowered their heart rates at level 140-160 beats per minute, but again, none lowered the ten per cent decrement of the mean resting heart rate. When the heart rate was maintained between 160-180 beats per minute, both experimental groups raised their mean heart rates after the conditioned stimulus, whereas the Control Group lowered their heart rates, overall. There were no significant differences between the groups as evidenced by statistical evaluation on pages 58-63, it was concluded that the three groups were homogeneous with respect to ability to lower the heart rate under exercise stress during the pretest.

## Comparison of the Experimental Groups During the Instrumental Conditioning Period

Each experimental subject in both experimental groups met every day for two days for a thirty minute individual instrumental conditioning practice period. Upon the basis of previous investigation, the subjects were provided a ten minute period at the beginning of each experimental session to establish a base level heart rate in a resting position. A ten per cent decrement of the mean resting heart rate upon command was considered as the level of acceptability for heart rate lowering while sitting. A conditioned stimulus--the verbal command "lower"--for heart rate lowering was presented to each subject four times each experimental period. A thirty second interval, after the verbal command, was established through preliminary investigation as adequate time for heart rate lowering to occur. Each stimulus-response pattern or trial was followed by a two minute relaxation period before the next trial. Each experimental subject was required to lower her heart rate ten per cent of the daily resting heart rate on three of the four trials presented each day, for two consecutive days to meet the criterion established for learning in this study. Each subject continued the conditioning period for the full ten days even if she met the criterion level sooner. It should be noted that Experimental Group II, the group which did not receive immediate visual feedback, lowered their heart rates more than did Experimental Group I upon seven of the ten experimental days in the sitting position. Table 3 presents data with reference to learning times during the conditioning period. Figure 1 presents the learning curves for each experimental group.

TABLE 3

MEAN CHANGE SCORES OF INSTRUMENTAL CONDITIONING PERIOD*

| | Experimental Group I (n = 15) | | | Experimental Group II (n = 9) | | |
|---|---|---|---|---|---|---|
| Day | x for All Ss per day | X for Four Trials per S | X per trial | x for All Ss per day | X for Four Trials per S | X per Trial |
| 1 | -311.59 | -20.77 | - 5.19 | -245.99 | -27.33 | - 6.83 |
| 2 | -335.55 | -22.37 | - 5.59 | -289.04 | -32.12 | - 8.03 |
| 3 | -445.28 | -29.61 | - 7.42 | -268.74 | -29.86 | - 7.47 |
| 4 | -661.33 | -44.09 | -11.02 | -277.42 | -30.82 | - 7.71 |
| 5 | -575.89 | -38.39 | - 9.60 | -351.01 | -39.00 | - 9.75 |
| 6 | -615.63 | -41.04 | -10.26 | -410.24 | -45.58 | -11.40 |
| 7 | -738.65 | -49.24 | -12.31 | -385.22 | -42.80 | -10.70 |
| 8 | -737.95 | -49.20 | -12.30 | -467.16 | -51.91 | -12.98 |
| 9 | -635.83 | -42.39 | -10.60 | -352.45 | -39.16 | - 9.79 |
| 10 | -713.19 | -47.55 | -11.89 | -460.74 | -51.19 | -12.80 |

*On the first day of the instrumental conditioning period, the subjects in Experimental Group I lowered their heart

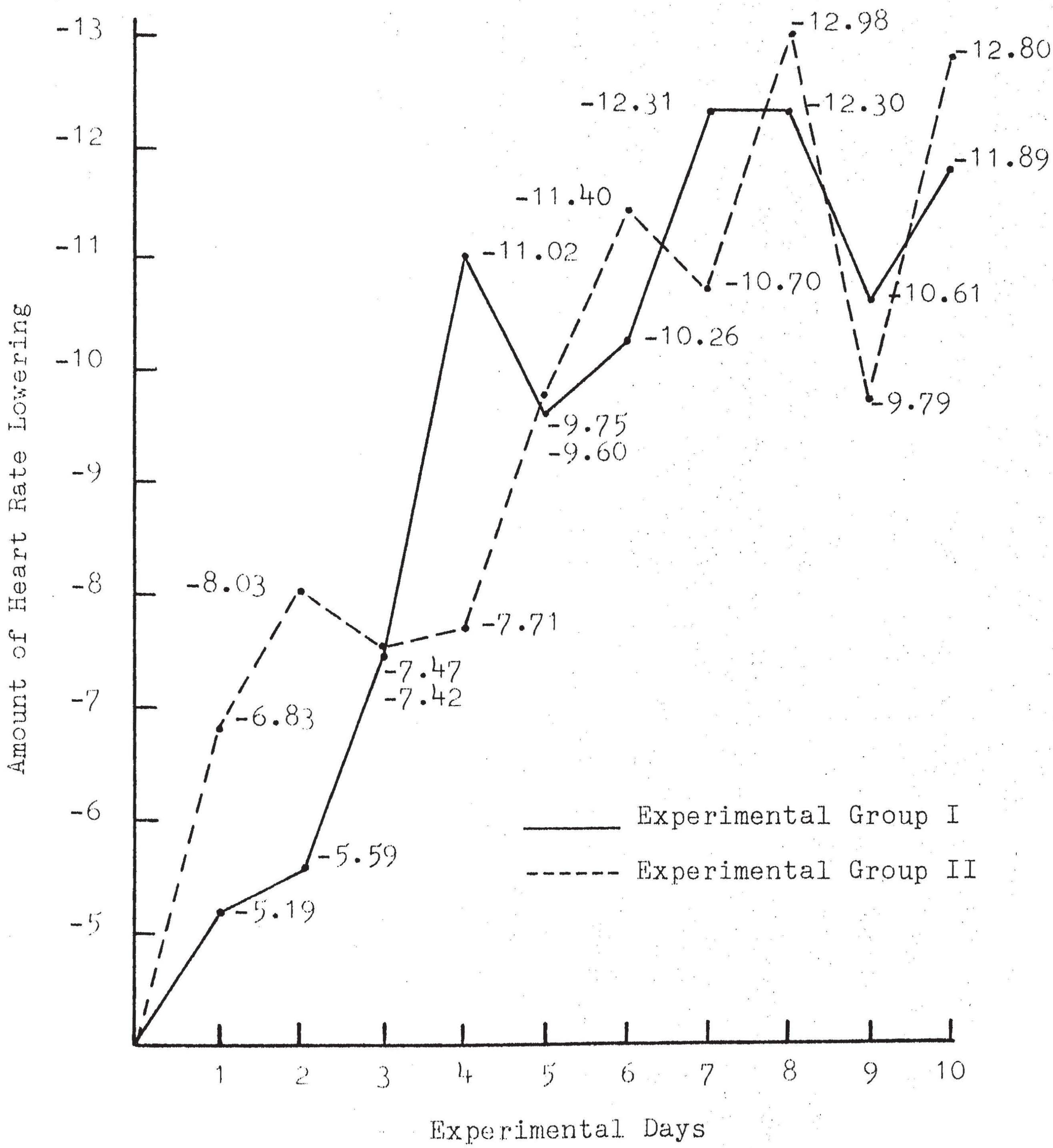


Fig. 1.--Mean values per trial of heart rate lowering for each subject in both experimental groups.

rates a total of -311.59 beats per minute. Each subject in Experimental Group I had a mean lowering value of -20.77 beats per minute for the total four trials (total sum of change values divided by number in the group). For each of the four trials, each subject in Experimental Group I had a mean value of -5.19 beats per minute (sum of mean values for four trials divided by number of trials, four in this instance).

It would appear that a plateau had been reached around the eighth day for both groups, for the mean values for both the ninth and tenth days were lower than those of the eighth day. Therefore, additional days in the instrumental conditioning period would probably not have led to a significant increase in ability to lower the heart rate in a sitting position.

### Comparison of the Groups Upon the Four Levels During the Pretest, Post-test I, and Post-test II

To determine the differences between the performances of each subject in the three groups at level 100-120 beats per minute, level 120-140 beats per minute, level 140-160 beats per minute, and level 160-180 beats per minute upon the pretest, post-test I, and post-test II, a three-way analysis of variance with repeated measures upon two factors was utilized by the investigator. The descriptive data and resulting F ratios of the analysis of variance are shown in Table 4 and Table 5, respectively.

TABLE 4

MEAN VALUE DATA FOR HEART RATE LOWERING UNDER EXERCISE STRESS (IN BEATS PER MINUTE)

| Group | Level | Pretest | Post-test I | Post-test II |
|---|---|---|---|---|
| Experimental Group I | 100 | -3.6380 | -7.8053 | - 7.5067 |
| | 120 | +0.2247 | -9.0287 | -11.9733 |
| | 140 | -2.8873 | -8.5527 | -10.4413 |
| | 160 | +2.6013 | -9.6940 | -12.6887 |
| Experimental Group II | 100 | -1.6967 | -6.5456 | - 3.8122 |
| | 120 | -2.0533 | -7.9455 | - 5.5111 |
| | 140 | -4.1278 | -8.5133 | - 9.3567 |
| | 160 | +1.8478 | -9.3755 | - 8.3744 |
| Control Group | 100 | -1.3855 | -2.8464 | + 1.5400 |
| | 120 | +1.7945 | -0.0809 | - 0.5355 |
| | 140 | -2.5582 | -2.9645 | + 1.8636 |
| | 160 | -1.1809 | -1.8000 | - 0.7464 |

TABLE 5

SUMMARY TABLE FOR ANALYSIS OF VARIANCE FOR GROUPS UPON THE FOUR LEVELS DURING THE PRETEST, POST-TEST I, AND POST-TEST II

| Source | SS | df | ms | F | p |
|---|---|---|---|---|---|
| Between Subjects | 6,140.15 | 34 | | | |
| Groups | 2,913.15 | 2 | 1456.78 | 14.45 | < .001 |
| $Error_b$ | 3,226.60 | 32 | 100.83 | | |
| Within Subjects | 21,105.36 | 385 | | | |
| Tests | 2,461.78 | 2 | 1230.89 | 7.76 | < .001 |
| Levels | 137.44 | 3 | 45.81 | 0.97 | > .05 |
| G X T | 1,720.29 | 4 | 430.07 | 2.71 | < .05 |
| G X L | 188.02 | 6 | 31.34 | 0.66 | > .05 |
| T X L | 692.01 | 6 | 115.34 | 24.08 | < .001 |
| G X T X L | 288.78 | 12 | 24.07 | 5.03 | < .001 |
| $Error_1$ | 10,155.99 | 64 | 158.69 | | |
| $Error_2$ | 4,541.56 | 96 | 47.31 | | |
| $Error_3$ | 919.49 | 192 | 4.79 | | |
| Total | 27,245.51 | 419 | | | |

$F_{(2,32)}(.001) = 8.77$

$F_{(6,192)}(.001) = 3.74$

$F_{(2,64)}(.05) = 7.76$

$F_{(12,192)}(.001) = 2.74$

$F_{(4,64)}(.05) = 2.52$

Based upon the data presented in Table 5, there was a highly significant difference in ability to lower heart rate under exercise stress between the three groups at the .001 level; there was a highly significant difference in ability to lower heart rate during exercise stress with reference to the pretest, post-test I, and post-test II at the .001 level; there was no significant difference in ability to lower heart rate under different levels of exercise stress; there was significant interaction in terms of the way the groups performed over the tests at the .05 level; there was no significant interaction between groups and levels; there was a highly significant interaction between tests and levels at the .001 level; and there was a highly significant interaction between groups by tests by levels at the .001 level. To determine more specifically where the significant differences were found, a subsequent test, the Duncan's Multiple Range Test was utilized to test the pair-wise differences between the thirty-six means yielded by the three groups at four levels upon three tests. The results of the Duncan's Multiple Range Test are presented in Table 6, page 60 and in Table 7, page 61.

At the assigned .01 level of significance, Duncan's Multiple Range Test yielded no significant differences with reference to the change of each group in performance from test to test at the level 100-120 beats per minute; there were no significant differences at level 100-120 beats per minute between the groups during each test, except that Experimental Group I showed significantly more lowering than did the Control Group during post-test II.

At level 120-140 beats per minute, the performance of Experimental Group I in terms of ability to lower heart rate during exercise stress was significantly poorer during the pretest than their performance upon post-test I and post-test II, yielding mean values of +0.22 beats per minute

# TABLE 6

DUNCAN'S MULTIPLE RANGE TEST OF THIRTY-SIX MEANS YIELDED BY THREE GROUPS AT FOUR LEVELS UPON THREE TESTS

| | -12.69 | -11.97 | -10.44 | -9.69 | -9.38 | -9.36 | -9.03 | -8.55 | -8.51 | -8.37 | -7.95 | -7.81 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -12.69 | | 0.72 | 2.25 | 3.00 | 3.31 | 3.33 | 3.66 | 4.14 | 4.18 | 4.32 | 4.74 | 4.88 |
| -11.97 | | | 1.53 | 2.28 | 2.59 | 2.61 | 2.94 | 3.42 | 3.46 | 3.60 | 4.02 | 4.16 |
| -10.44 | | | | 0.75 | 1.06 | 1.08 | 1.41 | 1.89 | 1.93 | 2.07 | 2.49 | 2.63 |
| -9.69 | | | | | 0.31 | 0.33 | 0.66 | 1.14 | 1.18 | 1.32 | 1.74 | 1.88 |
| -9.38 | | | | | | 0.02 | 0.35 | 0.83 | 0.87 | 1.01 | 1.43 | 1.57 |
| -9.36 | | | | | | | 0.33 | 0.81 | 0.85 | 0.99 | 1.41 | 1.55 |
| -9.03 | | | | | | | | 0.48 | 0.52 | 0.66 | 1.08 | 1.22 |
| -8.55 | | | | | | | | | 0.04 | 0.18 | 0.60 | 0.74 |
| -8.51 | | | | | | | | | | 0.14 | 0.56 | 0.70 |
| -8.37 | | | | | | | | | | | 0.42 | 0.56 |
| -7.95 | | | | | | | | | | | | 0.14 |

| | -7.51 | -6.55 | -5.51 | -4.13 | -3.81 | -3.64 | -2.96 | -2.89 | -2.85 | -2.56 | -2.05 | -1.80 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -12.69 | 5.18 | 6.14 | 7.18* | 8.56* | 8.88* | 9.05* | 9.73* | 9.80* | 9.84* | 10.13* | 10.64* | 10.89* |
| -11.97 | 4.46 | 5.42 | 6.46 | 7.84* | 8.16* | 8.33* | 9.01* | 9.08* | 9.12* | 9.41* | 9.92* | 10.17* |
| -10.44 | 2.93 | 3.89 | 4.93 | 6.31 | 6.63* | 6.80* | 7.48* | 7.55* | 7.59* | 7.88* | 8.39* | 8.64* |
| -9.69 | 2.18 | 3.14 | 4.18 | 5.56 | 5.88 | 6.05 | 6.73* | 6.80* | 6.84* | 7.13* | 7.64* | 7.89* |
| -9.38 | 1.87 | 2.83 | 3.87 | 5.25 | 5.57 | 5.74 | 6.42 | 6.49* | 6.53* | 6.82* | 7.33* | 7.58* |
| -9.36 | 1.85 | 2.81 | 3.85 | 5.23 | 5.55 | 5.72 | 6.40 | 6.47 | 6.51 | 6.80* | 7.31* | 7.56* |
| -9.03 | 1.52 | 2.48 | 3.52 | 4.90 | 5.22 | 5.39 | 6.07 | 6.14 | 6.18 | 6.47 | 6.98* | 7.23* |
| -8.55 | 1.04 | 2.00 | 3.04 | 4.42 | 4.74 | 4.91 | 5.59 | 5.66 | 5.70 | 5.99 | 6.50* | 6.75* |
| -8.51 | 1.00 | 1.96 | 3.00 | 4.38 | 4.70 | 4.87 | 5.55 | 5.62 | 5.66 | 5.95 | 6.46* | 6.71* |
| -8.37 | 0.86 | 1.82 | 2.86 | 4.24 | 4.56 | 4.73 | 5.41 | 5.48 | 5.52 | 5.81 | 6.32 | 6.57* |
| -7.95 | 0.44 | 1.40 | 2.44 | 3.82 | 4.14 | 4.31 | 4.99 | 5.06 | 5.10 | 5.39 | 5.90 | 6.15 |
| -7.81 | 0.30 | 1.26 | 2.30 | 3.68 | 4.00 | 4.17 | 4.85 | 4.92 | 4.96 | 5.25 | 5.76 | 6.01 |
| -7.51 | | 0.96 | 2.00 | 3.38 | 3.70 | 3.87 | 4.55 | 4.62 | 4.66 | 4.95 | 5.46 | 5.71 |
| -6.55 | | | 1.04 | 2.42 | 2.74 | 2.91 | 3.59 | 3.66 | 3.70 | 3.99 | 4.50 | 4.75 |
| -5.51 | | | | 1.38 | 1.70 | 1.87 | 2.55 | 2.62 | 2.66 | 2.95 | 3.46 | 3.71 |
| -4.13 | | | | | 0.32 | 0.49 | 1.17 | 1.24 | 1.28 | 1.57 | 2.08 | 2.33 |
| -3.81 | | | | | | 0.17 | 0.85 | 0.92 | 0.96 | 1.25 | 1.76 | 2.01 |
| -3.64 | | | | | | | 0.68 | 0.75 | 0.79 | 1.08 | 1.59 | 1.84 |
| -2.96 | | | | | | | | 0.07 | 0.11 | 0.40 | 0.91 | 1.16 |
| -2.89 | | | | | | | | | 0.04 | 0.33 | 0.84 | 1.09 |
| -2.85 | | | | | | | | | | 0.29 | 0.80 | 1.05 |
| -2.56 | | | | | | | | | | | 0.51 | 0.76 |
| -2.05 | | | | | | | | | | | | 0.25 |

| | -1.70 | -1.39 | -1.18 | -0.75 | -0.54 | -0.08 | 0.22 | 1.54 | 1.79 | 1.85 | 1.86 | 2.60 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -12.69 | 10.99* | 11.30* | 11.51* | 11.94* | 12.15* | 12.61* | 12.91* | 14.23* | 14.48* | 14.54* | 14.55* | 15.29* |
| -11.97 | 10.27* | 10.58* | 10.79* | 11.22* | 11.43* | 11.89* | 12.19* | 13.51* | 13.76* | 13.82* | 13.83* | 14.57* |
| -10.44 | 8.74* | 9.05* | 9.26* | 9.69* | 9.90* | 10.36* | 10.66* | 11.98* | 12.23* | 12.29* | 12.30* | 13.04* |
| -9.69 | 7.99* | 8.30* | 8.51* | 8.94* | 9.15* | 9.61* | 9.91* | 11.23* | 11.48* | 11.54* | 11.55* | 12.29* |
| -9.38 | 7.68* | 7.99* | 8.20* | 8.63* | 8.84* | 9.30* | 9.60* | 10.92* | 11.17* | 11.23* | 11.24* | 11.98* |
| -9.36 | 7.66* | 7.97* | 8.18* | 8.61* | 8.82* | 9.28* | 9.58* | 10.90* | 11.15* | 11.21* | 11.22* | 11.96* |
| -9.03 | 7.33* | 7.64* | 7.85* | 8.28* | 8.49* | 8.95* | 9.25* | 10.57* | 10.82* | 10.88* | 10.89* | 11.63* |
| -8.55 | 6.85* | 7.16* | 7.37* | 7.80* | 8.01* | 8.47* | 8.77* | 10.09* | 10.34* | 10.40* | 10.41* | 11.15* |
| -8.51 | 6.81* | 7.12* | 7.33* | 7.76* | 7.97* | 8.43* | 8.73* | 10.05* | 10.30* | 10.36* | 10.37* | 11.11* |
| -8.37 | 6.67* | 6.98* | 7.19* | 7.62* | 7.83* | 8.29* | 8.59* | 9.91* | 10.16* | 10.22* | 10.23* | 10.97* |
| -7.95 | 6.25 | 6.56* | 6.77* | 7.20* | 7.41* | 7.87* | 8.17* | 9.49* | 9.74* | 9.80* | 9.81* | 10.55* |
| -7.81 | 6.11 | 6.42 | 6.63* | 7.06* | 7.27* | 7.73* | 8.03* | 9.35* | 9.60* | 9.66* | 9.67* | 10.41* |
| -7.51 | 5.81 | 6.12 | 6.33 | 6.76* | 6.97* | 7.43* | 7.73* | 9.05* | 9.30* | 9.36* | 9.37* | 10.11* |
| -6.55 | 4.85 | 5.16 | 5.37 | 5.80 | 6.01 | 6.47 | 6.77* | 8.09* | 8.34* | 8.40* | 8.41* | 9.15* |
| -5.51 | 3.81 | 4.12 | 4.33 | 4.76 | 4.97 | 5.43 | 5.73 | 7.05* | 7.30* | 7.36* | 7.37* | 8.11* |
| -4.13 | 2.43 | 2.74 | 2.95 | 3.38 | 3.59 | 4.05 | 4.35 | 5.67 | 5.92 | 5.98 | 5.99 | 6.73* |
| -3.81 | 2.11 | 2.42 | 2.63 | 3.06 | 3.27 | 3.73 | 4.03 | 5.35 | 5.60 | 5.66 | 5.67 | 6.41 |
| -3.64 | 1.94 | 2.25 | 2.46 | 2.89 | 3.10 | 3.56 | 3.86 | 5.18 | 5.43 | 5.49 | 5.50 | 6.24 |
| -2.96 | 1.26 | 1.57 | 1.78 | 2.21 | 2.42 | 2.88 | 3.18 | 4.50 | 4.75 | 4.81 | 4.82 | 5.56 |
| -2.89 | 1.19 | 1.50 | 1.71 | 2.14 | 2.35 | 2.81 | 3.11 | 4.43 | 4.68 | 4.74 | 4.75 | 5.49 |
| -2.85 | 1.15 | 1.46 | 1.67 | 2.10 | 2.31 | 2.77 | 3.07 | 4.39 | 4.64 | 4.70 | 4.71 | 5.45 |
| -2.56 | 0.86 | 1.17 | 1.38 | 1.81 | 2.02 | 2.48 | 2.78 | 4.10 | 4.35 | 4.41 | 4.42 | 5.16 |
| -2.05 | 0.35 | 0.66 | 0.87 | 1.30 | 1.51 | 1.97 | 2.27 | 3.59 | 3.84 | 3.90 | 3.91 | 4.65 |
| -1.80 | 0.10 | 0.41 | 0.62 | 1.05 | 1.26 | 1.72 | 2.02 | 3.34 | 3.59 | 3.65 | 3.66 | 4.40 |
| -1.70 | | 0.31 | 0.52 | 0.95 | 1.16 | 1.62 | 1.92 | 3.24 | 3.49 | 3.55 | 3.56 | 4.30 |
| -1.39 | | | 0.21 | 0.64 | 0.85 | 1.31 | 1.61 | 2.93 | 3.18 | 3.24 | 3.25 | 3.99 |
| -1.18 | | | | 0.43 | 0.64 | 1.10 | 1.40 | 2.72 | 2.97 | 3.03 | 3.04 | 3.78 |
| -0.75 | | | | | 0.21 | 0.67 | 0.97 | 2.29 | 2.54 | 2.60 | 2.61 | 3.35 |
| -0.54 | | | | | | 0.46 | 0.76 | 2.08 | 2.33 | 2.39 | 2.40 | 3.14 |
| -0.08 | | | | | | | 0.30 | 1.62 | 1.87 | 1.93 | 1.94 | 2.68 |
| 0.22 | | | | | | | | 1.32 | 1.57 | 1.63 | 1.64 | 2.38 |
| 1.54 | | | | | | | | | 0.25 | 0.31 | 0.32 | 1.06 |
| 1.79 | | | | | | | | | | 0.06 | 0.07 | 0.81 |
| 1.85 | | | | | | | | | | | 0.01 | 0.75 |
| 1.86 | | | | | | | | | | | | 0.74 |

*Significant at the .01 level.

TABLE 7

ORDERED MEANS AND RESULTS OF DUNCAN'S MULTIPLE RANGE TEST WITH RESPECT TO VALUES YIELDED UPON HEART RATE LOWERING DURING EXERCISE STRESS BY THREE GROUPS AT FOUR LEVELS UPON THREE TESTS

| Group | Test | Level | Mean | Significance* |
|---|---|---|---|---|
| E I | Post II | 160 | -12.69 | |
| E I | Post II | 120 | -11.97 | |
| E I | Post II | 140 | -10.44 | |
| E I | Post I | 160 | -9.69 | |
| E II | Post I | 160 | -9.38 | |
| E II | Post II | 140 | -9.36 | |
| E I | Post I | 120 | -9.03 | |
| E I | Post I | 140 | -8.55 | |
| E II | Post I | 140 | -8.51 | |
| E II | Post II | 160 | -8.37 | |
| E II | Post I | 120 | -7.95 | |
| E I | Post I | 100 | -7.81 | |
| E I | Post II | 100 | -7.51 | |
| E II | Post I | 100 | -6.55 | |
| E II | Post II | 120 | -5.51 | |
| E II | Pre | 140 | -4.13 | |
| E II | Post II | 100 | -3.81 | |
| E I | Pre | 100 | -3.64 | |
| C | Post I | 140 | -2.96 | |
| E I | Pre | 140 | -2.89 | |
| C | Post I | 100 | -2.85 | |
| C | Pre | 140 | -2.56 | |
| E II | Pre | 120 | -2.05 | |
| C | Post I | 160 | -1.80 | |
| E II | Pre | 100 | -1.70 | |
| C | Pre | 100 | -1.39 | |
| C | Pre | 160 | -1.18 | |
| C | Post II | 160 | -0.75 | |
| C | Post II | 120 | -0.54 | |
| C | Post I | 120 | -0.08 | |
| E I | Pre | 120 | +0.22 | |
| C | Post II | 100 | +1.54 | |
| C | Pre | 120 | +1.79 | |
| E II | Pre | 160 | +1.85 | |
| C | Post II | 140 | +1.86 | |
| E I | Pre | 160 | +2.60 | |

*Any means not connected by a common line are significantly different.

upon the pretest, -9.03 beats per minute upon post-test I, and -11.97 beats per minute upon the post-test II. The mean change values of Experimental Group I upon post-test I and post-test II were not significantly different. Performances of the Control Group and Experimental Group II did not differ significantly during the pretest or during either post-test. The values of the three groups were not significantly different from each other at the pretest of level 120-140 beats per minute at the .01 level. During post-test I, both experimental groups differed significantly from the Control Group--exhibiting the ability to lower the heart rate significantly more during exercise stress at level 120-140 beats per minute than did the Control Group--as evidenced by mean values of -9.03 beats per minute tor Experimental Group I, -7.95 beats per minute for Experimental Group II, and -0.08 beats per minute for the Control Group; the two experimental groups were not significantly different from each other during post-test I. During post-test II, the mean values of Experimental Group I were significantly lower than those of the Control Group, while no other differences were significant during post-test II at level 120-140 beats per minute.

No significant differences in mean values were found at level 140-160 beats per minute for the Control Group or Experimental Group II during the pretest or either post-test. The performances of the subjects in Experimental Group I were different at the .01 level of significance between the pretest and post-test II, with mean values of -2.89 beats per minute upon the pretest, and -10.44 beats per minute upon post-test II. Other mean values of Experimental Group I did not differ significantly during other test comparisons. The mean change between the three groups did not differ significantly upon either the pretest or upon post-test I. However, both experimental groups were different from the Control Group at the .01 level of significance upon post-test II, but the experimental groups did not differ significantly from each other upon this test.

Level 160-180 beats per minute yielded no significant differences for the Control Group between pretest and either post-test; the values of both experimental groups showed a significant difference between the pretest and both post-tests, while the post-tests did not differ from each other. There were no significant differences between groups upon the pretest at this level; both experimental groups lowered their heart rates significantly more than did the Control Group upon both post-tests, while the experimental groups did not differ from each other. Figure 2 presents the mean change values of each of the three groups at four levels upon the three tests. Figure 2 indicates that there was interaction between groups, tests, and levels with respect to ability to lower the heart rate under exercise stress, based upon the selected significance level.

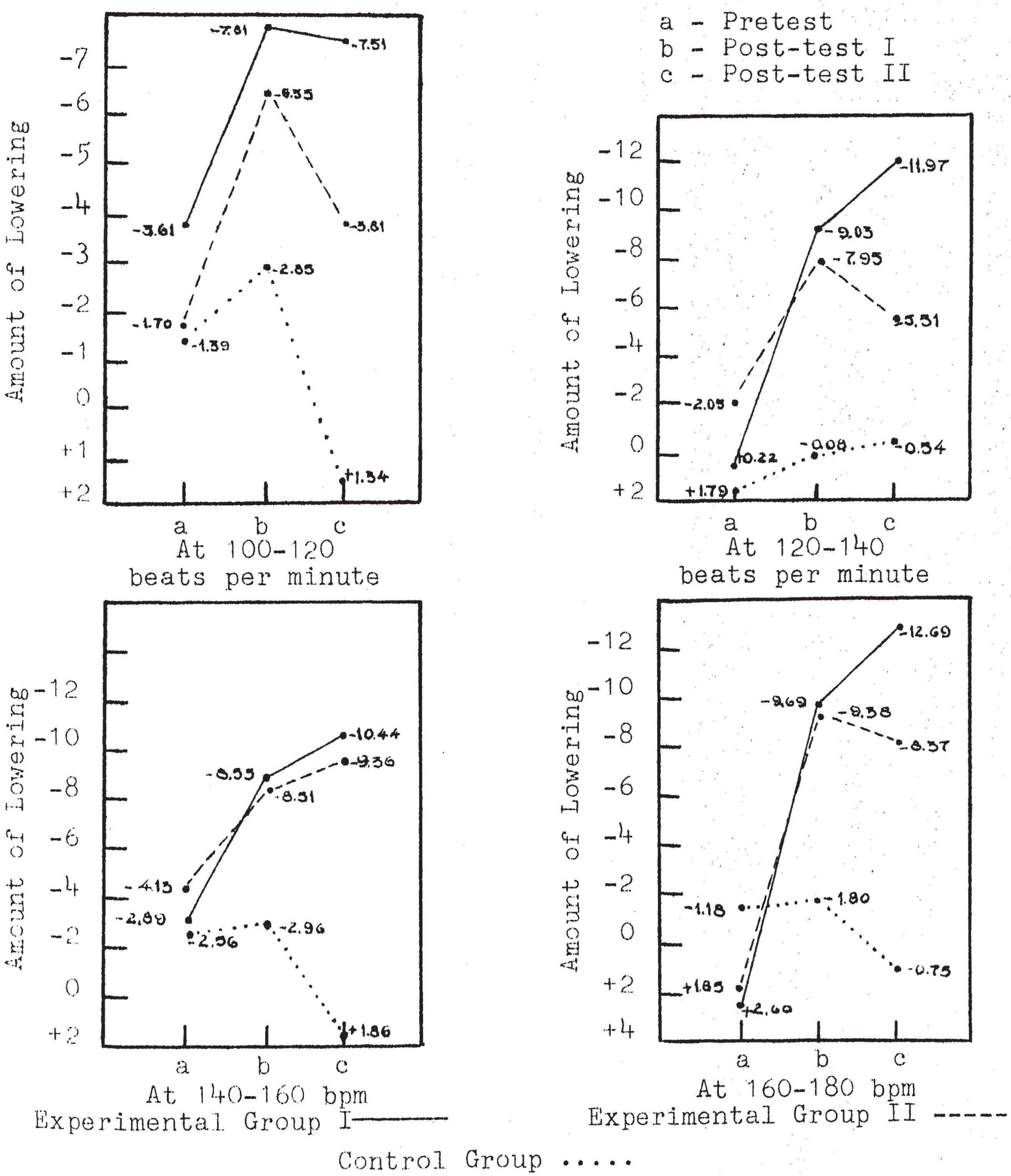


Fig. 2.--Mean values of heart rate lowering depicting the interactions of the three groups at four levels upon three tests.

At level 100-120 beats per minute, both experimental groups made marked increases in ability to lower heart rate during exercise stress from the pretest to post-test I, while the Control Group yielded only a small change, as evidenced by mean change values of -3.61 beats per minute upon the pretest to -7.81 beats per minute upon post-test I for Experimental Group I, -1.70 beats per minute upon the pretest to -6.55 beats per minute upon post-test I for Experimental Group II, and -1.39 beats per minute upon the pretest to -2.85 beats per minute upon the post-test I for the Control Group. From post-test I to post-test II, Experimental Group II and the Control Group dropped markedly in their ability to lower heart rate during exercise stress--they did not lower their heart rates as much during post-test II as they did in post-test I, while Experimental Group I dropped only slightly.

Experimental Group II performed better than either Experimental Group I or the Control Group at level 120-140 beats per minute during the pretest. Values upon post-test I revealed that Experimental Group I lowered their heart rates more than Experimental Group II, although both groups increased greatly in their ability to lower heart rate during exercise stress from the pretest, differing significantly from the Control Group who lowered only slightly more upon post-test I than upon the pretest. Experimental Group I continued to lower more upon post-test II than they did in post-test I and maintained a significant difference from the Control Group. Experimental Group II raised the mean value of heart rate from post-test I to post-test II--they did not lower as much upon the second post-test as they did upon the first post-test, as mean change values dropped from -7.95 beats per minute upon post-test I to -5.51 beats per minute upon post-test II.

Experimental Group II continued to perform better than either the Experimental Group I or the Control Group at level 140-160 beats per minute upon the pretest. Both the experimental groups increased their ability to lower the heart rate to almost identical mean values of -8.55 beats per minute for Experimental Group I and -8.51 beats per minute for Experimental Group II upon post-test I, while the Control Group remained virtually the same. Both experimental groups increased again--they lowered their heart rates more upon post-test II than upon post-test I--while the Control Group did not lower their mean heart rate as much upon post-test II as they did upon post-test I, as evidenced by mean values of -2.96 beats per minute upon post-test I to +1.86 beats per minute upon post-test II. This decrease by the Control Group was probably responsible for the fact that both experimental groups lowered significantly more than did the Control Group upon post-test II.

At level 160-180 beats per minute, the Control Group was the only group to lower their mean heart rate, as a group, upon the pretest (mean = -1.18 beats per minute)--

post-test I to post-test II--they did not lower as much upon the second post-test as they did upon the first post-test, as mean change values dropped from -7.95 beats per minute upon post-test I to -5.51 beats per minute upon post-test II.

Experimental Group II continued to perform better than either the Experimental Group I or the Control Group at level 140-160 beats per minute upon the pretest. Both the experimental groups increased their ability to lower the heart rate to almost identical mean values of -8.55 beats per minute for Experimental Group I and -8.51 beats per minute for Experimental Group II upon post-test I, while the Control Group remained virtually the same. Both experimental groups increased again--they lowered their heart rates more upon post-test II than upon post-test I--while the Control Group did not lower their mean heart rate as much upon post-test II as they did upon post-test I, as evidenced by mean values of -2.96 beats per minute upon post-test I to +1.86 beats per minute upon post-test II. This decrease by the Control Group was probably responsible for the fact that both experimental groups lowered significantly more than did the Control Group upon post-test II.

At level 160-180 beats per minute, the Control Group was the only group to lower their mean heart rate, as a group, upon the pretest (mean = -1.18 beats per minute)--both experimental groups increased their heart rates, as shown by mean values of +1.85 beats per minute for Experimental Group II and +2.60 beats per minute for Experimental Group I upon the pretest. Again, both experimental groups decreased their heart rates markedly upon post-test I and lowered significantly more than did the Control Group. From post-test I to post-test II, Experimental Group I increased their mean lowering values--as a group, they lowered more upon post-test II than upon post-test I, while Experimental Group II and the Control Group decreased slightly in mean lowering values, they lowered less upon post-test II then upon post-test I. The performance of both experimental groups remained significantly different from the performance of the Control Group, as evidenced by mean values of -12.6887 beats per minute for Experimental Group I, -8.3744 beats per minute for Experimental Group II, and -0.7464 beats per minute for the Control Group.

## Discussion of the Results

The significant change in ability to lower heart rate from pretest to post-test I or post-test II is very evident at all levels for both experimental groups. At no point did either group fail to lower their heart rates upon either post-test, whereas the Control Group increased their mean heart rate at level 140-160 beats per minute upon the second post-test. The smallest incidence of lowering for both experimental groups upon either post-test occurred at level 100-120 beats per minute, as evidenced by mean values of -7.31 beats per minute for Experimental Group I upon post-test I and -3.81 beats per minute for Experimental Group II upon post-test II. The greatest amount of lowering for the Control Group was a mean value of -2.96 beats per minute upon post-test I at level 140-160. Therefore, the greatest amount of lowering for the Control Group was less than the least amount of lowering for either experimental group. The experimental groups seem to have definitely been able to transfer the ability to lower the heart rate from the sitting position to the situation of exercise stress.

Experimental Group II lowered their mean heart rate to a greater extent during the instrumental conditioning period, seven of the ten sessions, than did Experimental Group I, but could not retain the ability to the same degree at each level upon both exercise post-tests. In other words, although Experimental Group II actually lowered their mean heart rate more during the instrumental conditioning period, Experimental Group I lowered more during conditions of exercise stress. Experimental Group I, who benefitted from immediate visual feedback, could tell from the readout of the biotachometer almost exactly when they had lowered the required ten per cent decrement of their resting heart rate. But Experimental Group II, who received no visual feedback, did not know when they had reached the decrement, or even if they were lowering their heart rates at all; therefore, perhaps they made greater effort to attain some type of internalized cues that they could acknowledge as heart rate lowering. Several members of Experimental Group II mentioned that they could feel an internal change as they attempted to lower their heart rates. Although there is no proof of this awareness of change, the response of heart rate lowering could have been caused by a form of classical conditioning--conditioning to an internalized cue not acknowledged by the investigator. Another possible reason for the positive performance of Experimental Group II could be caused by feedback from their peer group. After the experimental sessions, it is possible that members of Experimental Group I, who knew they were lowering their heart rates, discussed their results with members of Experimental Group II, who were not aware of their results. Because members of Experimental Group I were successful in their attempts to lower their heart rates, members of Experimental Group II assumed that they, too, were successful in heart rate lowering. This form of peer group reinforcement served as delayed feedback. The procedures followed in the post-tests were the same as for the pretest. Both groups were allowed to watch the results of their performance upon the tachometer, but most of the subjects in Experimental Group II preferred to attempt the task of lowering the heart rate under exercise stress during the post-tests as they had been conditioned--with no visual feedback. It should be noted that the members of Experimental Group II did not know the results of any of their conditioning sessions until after the experimental period was concluded.

Out of twenty-four experimental subjects in both experimental groups, twenty-two met the criterion of learning to lower the heart rate in a sitting position (each subject was required to lower her heart rate ten per cent of the daily resting heart rate, three of the four trials presented each day, for two consecutive days). Thirteen of fifteen subjects in Experimental Group I who received feedback and nine of nine subjects in Experimental Group II who did not receive immediate feedback met this criterion. Both persons who did not meet this criterion for learning were members of Experimental Group I who received the immediate feedback, but upon the post-tests, both subjects exhibited evidence of heart rate lowering under exercise stress.

Both experimental groups exhibited the greatest incidence of lowering at level 160-180 beats per minute, as evidenced by mean values of -12.69 beats per minute for Experimental Group I upon post-test II and -9.38 beats per minute for Experimental Group II upon post-test I. The subjects themselves seemed to feel that it was much easier to lower their heart rates from a higher level, 160-180 beats per minute, than from a lower level, 100-120 beats per minute, and this is also evidenced by the values. This is directly contrary to the findings of Mize who stated:

> . . . as the heart rate of the subjects accelerated, and theoretically became more difficult to control because of the increase occurring to meet metabolic requirements, the tendency was for the amount of control after the conditioned stimulus to decrease (Mize, 1970:45).

The contrary finding may be caused by the difference in design as Mize used a progressive test, while in the present study, the heart rate was allowed to stabilize before the conditioned stimulus was presented. It is also interesting to note that the least evidence of lowering of Experimental Group I was during the pretest, a mean value of +2.60 beats per minute at level 160-180 beats per minute; the greatest evidence of heart rate lowering during exercise stress also occurred at level 160-180 beats per minute--a mean value of -12.69 beats per minute for Experimental Group I.

## Summary

Chapter IV presented an analysis of the data. The subjects, who volunteered for the experiment, were assigned randomly to one of three groups, two experimental and one control, upon the basis of the mean resting heart rate obtained prior to the pretest period. Experimental Group I was composed of fifteen subjects who practiced volitional control of heart rate with visual feedback during the instrumental conditioning period; Experimental Group II was composed of nine subjects who also practiced volitional control of heart rate during the instrumental conditioning period without the benefit of visual feedback or any other information that would allow them to know the extent of their practice control until after the experimental period when the subjects were told if they met the criterion of learning; the Control Group was composed of eleven subjects who did not participate in the conditioning period. The purpose of this investigation was to determine if heart rate lowering could be conditioned instrumentally during exercise stress.

Mean resting heart rates of all subjects in each of the three groups were initially subjected to a one-way analysis of variance to determine the homogeneity of the groups. The $F$ ratio indicated that the three groups did not differ significantly upon mean resting heart rates. Duncan's Multiple Range Test showed that there was no significant difference between groups upon performance in the pretest, indicating that the three groups did not differ significantly prior to the beginning of the conditioning period upon ability to lower the heart rate during exercise stress.

Mean lowering values of the two experimental groups were presented with reference to the instrumental conditioning period. Experimental Group II lowered more than did Experimental Group I upon seven of the ten days of conditioning.

The values for the subjects in each of the three groups upon the pretest and both post-tests were subjected to a three-way analysis of variance with repeated measures upon two factors. Highly significant differences were found between groups, between tests, tests by levels, and between groups by tests by levels at the .001 level; a significant interaction was found between groups by tests at the .05 level.

Duncan's Multiple Range Test showed that Experimental Group I differed significantly from the Control Group at all levels with reference to heart rate lowering under exercise stress; and that Experimental Group II differed significantly from the Control Group at all levels except 100-120 beats per minute. Experimental Group I did not differ significantly from Experimental Group II at any of the four levels, although Experimental Group I lowered their mean heart rate more than did the Experimental Group II at each of the four levels upon each post-test.

Chapter V will present a summary, a conclusion of the study, and recommendations for further studies.

CHAPTER V

# SUMMARY, FINDINGS, CONCLUSION, AND RECOMMENDATIONS FOR FURTHER STUDIES

## Summary of the Investigation

Much controversy exists with reference to the traditional belief that instrumental learning is possible only for voluntary control of skeletal responses, and that classical conditioning is possible only for involuntary control of visceral and emotional responses. The assumption that visceral responses cannot be learned in the same way as can skeletal responses has been refuted recently by research. Miller has postulated that there is only one kind of learning; therefore, visceral responses can be learned just as skeletal responses can be learned. Research has shown positive results with reference to the instrumental learning of visceral responses by animals and human beings.

The study that brought the problem of instrumental conditioning of visceral responses to the attention of psychophysiological profession was reported by Miller and Carmona, who found that dogs could be conditioned instrumentally to increase or decrease salivation. Trowill found that curarized rats rewarded for a slow heart rate decreased their heart rate significantly; those rewarded for a fast heart rate increased their heart rate significantly also. Highly reliable changes in the heart rate of rats were reported by Miller and DiCara. Other studies reported successful operant conditioning techniques in increasing and decreasing heart rate to avoid shock; in changes in intestinal contraction and heart rate; in urine formation; and in systolic blood pressure.

Shearn published one of the first reports of conditioning human heart rate operantly. He found that experimental subjects were able to accelerate their heart rates to delay shock pulses. Hnatiow and Lang, who found that aversive reinforcement was unnecessary, and conditioned subjects to decrease heart rate variability without this reinforcement.

Engel completed three studies with reference to conditioning of heart rate by means of operant procedures: five of ten experimental subjects learned to slow their heart rates; all experimental subjects learned to speed their heart rates; and subjects gained minute-to-minute control of heart rate when taught to increase and decrease cyclically.

Brener and Hothersall showed that under conditions of augmented sensory feedback, subjects learn rapidly to control their heart rates. Using operant procedures to condition subjects to exercise voluntary control over heart rate, Frazier reported that punishment avoidance contingencies were effective in imposing control over heart rate.

Mize investigated the possibility that heart rate slowing could be conditioned instrumentally under exercise stress. She concluded that instrumental conditioning during the resting state appears to facilitate heart rate lowering in the exercise stress situation measured, but not to a statistically significant degree.

These previous studies have indicated that heart rate responses mediated by the autonomic nervous system can be conditioned instrumentally, whether instrumental learning of heart rate can occur during exercise stress has not been determined. deVries states that "high heart rates are less efficient than low rates, other things being equal. . . . The slower the heart rate for any given workload, the more efficiently is the cardiac work performed." This concept is based upon three ideas: (1) oxygen consumption of the heart increases with increasing heart rate, even though the workload is held constant; (2) as the rate increases, the filling time of the heart decreases, and (3) diastasis, the only resting period for the myocardium, is disproportionately shortened in faster rates, and may disappear entirely at high rates. If a person is able to lower consciously her heart rate during exercise stress, the body may be able to adjust and work more efficiently. Thus, because of the possible adaptation of the body to the lower heart rate, several positive changes in performances could occur: (1) longer duration of effort before exhaustion; (2) greater utilization of energy reserves; and (3) more rapid return of heart rate and blood pressure to normal following activity. In essence, the volitional control of heart rate suggests the potential of less circulatory stress during physical activity.

The general purpose of the study was to determine if heart rate lowering could be instrumentally conditioned during exercise stress. It was hypothesized that there would be no significant difference in heart rate lowering of those subjects in Experimental Group I who received instrumental conditioning with immediate feedback, in Experimental Group II who received instrumental conditioning with delayed feedback, and in the Control Group who received no conditioning.

Thirty-five female volunteer students from Eastern Illinois University in Charleston, Illinois, were selected to participate in the study. The students were divided into three groups, two experimental and one control. The subjects were found to be equated upon a mean resting heart rate taken prior to the initial experimental measures.

A practice session was conducted prior to the experimental session, in which all subjects were familiarized with the technique of treadmill walking. Another practice session was held to establish approximate work loads for each individual subject at each of the four levels--100-120 beats per minute, 120-140 beats per minute, 140-160 beats per minute, and 160-180 beats per minute. The workload was the maximum amount of work upon the treadmill which would allow the subject to stabilize her heart rate plus or minus five heart beats within the level for at least one minute duration. A pretest was then given to all subjects in which they were asked to lower their heart rates at a given conditioned stimulus (the word "lower" given by the investigator) after they had reached the designated level, which was assigned randomly. The experimental groups were then exposed to ten days of conditioning, thirty minutes a day, in which they were given four trials each day to attempt to lower their heart rates in a sitting position. After the conditioning period was over, both the Control Group and the experimental groups were again given the test of heart rate lowering during exercise stress as previously described. This post-test was administered twice upon two consecutive days to provide a more reliable value for heart rate lowering during exercise stress.

An analysis of variance technique was selected to test the significance of the difference between the three groups at four levels upon three tests with respect to ability to lower the heart rate under exercise stress. A subsequent test, Duncan's Multiple Range Test, was utilized to test the pair-wise differences between the thirty-six means yielded by the three groups at four levels upon three tests.

## Findings of the Study

The following statements reveal the findings of the study:

1. Twenty-two of the twenty-four experimental subjects exposed to instrumental conditioning over a ten day period met the criterion of learning to lower the heart rate in a sitting position. The group included thirteen of fifteen members of Experimental Group I and nine of nine members of Experimental Group II. The two persons who did not meet the criterion for learning were in Experimental Group I which received immediate feedback, but upon administration of post-tests, both subjects exhibited heart rate lowering during exercise stress.
2. Experimental Group II who received instrumental conditioning with delayed feedback lowered their mean heart rate to a greater extent during the experimental period than did Experimental Group I who received instrumental conditioning with immediate visual feedback of the results upon seven of the ten practice days. However, Experimental Group I lowered more at each level upon both post-tests than did Experimental Group II.
3. Experimental Group I lowered their mean heart

rate significantly more than did the Control Group at all four levels of exercise stress at the .01 level. Experimental Group II lowered their mean heart rate significantly more than did the Control Group at all levels except level 100-120 beats per minute. Although Experimental Group I lowered their mean heart rate more than did Experimental Group II at each level upon both post-tests, none of these differences was significant.

4. Both experimental groups exhibited the greatest ability to lower the heart rate at level 160-180 beats per minute, as evidenced by mean values of -12.69 beats per minute for Experimental Group I and -9.38 beats per minute for Experimental Group II.

## Tests of Hypothesis

The hypothesis stated in the first chapter was tested upon the basis of the results of the analysis of data through the application of a three-way analysis of variance with repeated measures upon two factors and Duncan's Multiple Range Test. The results of the applied tests are presented below.

> There is no significant difference in heart rate lowering of those subjects in Experimental Group I who received instrumental conditioning with immediate feedback, in Experimental Group II who received instrumental conditioning with delayed feedback, and in the Control Group who received no conditioning.

The data collected for this study provided sufficient information for the investigator to reject the hypothesis. Experimental Group I lowered their mean heart rate significantly more than did the Control Group at each of the four levels upon the post-test. Experimental Group II lowered their mean heart rate significantly more than did the Control Group at each level except 100-120 beats per minute. There were no significant differences between experimental groups.

## Conclusion of the Study

It may be concluded that volitional control of the heart rate may be successfully accomplished under exercise stress. Control of the heart rate in a resting state appears to transfer and facilitate heart rate lowering during exercise stress.

## Recommendations for Further Studies

The following suggestions have been recommended for further investigation:

1. The ability to maintain a lower heart rate during exercise stress for a prolonged period.
2. The measurement of cardiac output before, during, and after volitional lowering of heart rate during exercise stress.

# APPENDICES

# RAW DATA FOR HEART RATE LOWERING DURING EXERCISE STRESS

## Experimental Group I - Immediate Feedback

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| MA | Pre-test | 80.88 | 100 | 104.35 | 100.84 | - 3.51 |
| | | | 120 | 123.71 | 118.81 | - 4.90 |
| | | | 140 | 146.34 | 142.86 | - 3.48 |
| | | | 160 | 160.00 | 166.67 | + 6.67 |
| | Post-test I | 76.27 | 100 | 115.38 | 111.11 | - 4.27 |
| | | | 120 | 127.66 | 118.81 | - 8.85* |
| | | | 140 | 142.86 | 131.87 | -10.99* |
| | | | 160 | 171.43 | 162.16 | - 9.27* |
| | Post-test II | 79.97 | 100 | 113.21 | 107.14 | - 6.07 |
| | | | 120 | 127.66 | 122.45 | - 5.21 |
| | | | 140 | 142.86 | 139.53 | - 3.33 |
| | | | 160 | 171.43 | 162.16 | - 9.27* |
| BB | Pretest | 82.22 | 100 | 113.21 | 92.31 | -20.90* |
| | | | 120 | 121.21 | 123.71 | + 2.50 |
| | | | 140 | 141.18 | 150.00 | + 8.82 |
| | | | 160 | 162.16 | 150.00 | -12.16* |
| | Post-test I | 75.02 | 100 | 109.09 | 104.35 | - 4.74 |
| | | | 120 | 122.45 | 115.38 | - 7.07 |
| | | | 140 | 150.00 | 142.86 | - 7.14 |
| | | | 160 | 162.16 | 150.00 | -12.16* |
| | Post-test II | 87.49 | 100 | 100.84 | 87.59 | -13.25* |
| | | | 120 | 126.32 | 110.09 | -16.23* |
| | | | 140 | 142.86 | 134.83 | - 8.03 |
| | | | 160 | 171.43 | 153.85 | -17.58* |

* $\leq$ ten per cent of the resting heart rate

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| SD | Pretest | 65.84 | 100 | 107.14 | 117.65 | +10.51 |
| | | | 120 | 120.00 | 121.21 | + 1.21 |
| | | | 140 | 142.86 | 150.00 | + 7.14 |
| | | | 160 | 169.01 | 169.01 | 0 |
| | Post-test I | 54.55 | 100 | 114.29 | 105.63 | - 8.66* |
| | | | 120 | 125.00 | 120.00 | - 5.00 |
| | | | 140 | 153.85 | 151.90 | - 1.95 |
| | | | 160 | 166.67 | 160.00 | - 6.67* |
| | Post-test II | 64.41 | 100 | 114.29 | 96.00 | -18.29* |
| | | | 120 | 121.21 | 113.21 | - 8.21* |
| | | | 140 | 146.34 | 141.18 | - 5.16 |
| | | | 160 | 180.82 | 175.47 | - 5.35 |
| SF | Pretest | 95.00 | 100 | 115.38 | 111.11 | - 4.27 |
| | | | 120 | 125.00 | 133.33 | + 8.33 |
| | | | 140 | 150.00 | 144.58 | - 5.42 |
| | | | 160 | 171.43 | 181.82 | +10.39 |
| | Post-test I | 86.18 | 100 | 115.38 | 111.11 | - 4.27 |
| | | | 120 | 120.00 | 118.81 | - 1.19 |
| | | | 140 | 140.53 | 138.93 | - 1.60 |
| | | | 160 | 162.16 | 157.89 | - 4.27 |
| | Post-test II | 88.70 | 100 | 114.29 | 103.45 | -10.84* |
| | | | 120 | 126.32 | 120.00 | - 6.32 |
| | | | 140 | 148.05 | 146.34 | - 1.71 |
| | | | 160 | 169.01 | 162.16 | - 6.85 |
| TH | Pretest | 89.27 | 100 | 100.00 | 107.14 | + 7.14 |
| | | | 120 | 122.45 | 130.43 | + 7.98 |
| | | | 140 | 148.05 | 150.00 | + 1.95 |
| | | | 160 | 176.47 | 187.50 | +11.03 |
| | Post-test I | 71.61 | 100 | 115.38 | 105.26 | -10.12* |
| | | | 120 | 125.00 | 122.45 | - 2.55 |
| | | | 140 | 148.05 | 129.03 | -19.02* |
| | | | 160 | 166.67 | 146.34 | -20.33* |
| | Post-test II | 86.00 | 100 | 107.14 | 108.11 | + 0.97 |
| | | | 120 | 123.71 | 115.38 | - 8.33 |
| | | | 140 | 150.00 | 129.03 | -20.97* |
| | | | 160 | 179.10 | 150.00 | -29.10* |

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| EH | Pretest | 90.91 | 100 | 109.09 | 109.09 | 0 |
| | | | 120 | 131.87 | 139.53 | + 7.66 |
| | | | 140 | 144.58 | 142.86 | - 1.72 |
| | | | 160 | 166.67 | 166.67 | 0 |
| | Post-test I | 96.04 | 100 | 113.21 | 111.11 | - 2.10 |
| | | | 120 | 127.66 | 127.66 | 0 |
| | | | 140 | 142.86 | 141.18 | - 1.68 |
| | | | 160 | 160.00 | 157.89 | - 2.11 |
| | Post-test II | 90.12 | 100 | 104.35 | 110.09 | + 5.74 |
| | | | 120 | 127.66 | 125.00 | - 2.66 |
| | | | 140 | 148.05 | 129.03 | -19.02* |
| | | | 160 | 171.43 | 160.00 | -11.43* |
| MK | Pretest | 90.68 | 100 | 111.11 | 96.77 | -14.34* |
| | | | 120 | 120.00 | 117.65 | - 2.35 |
| | | | 140 | 153.85 | 137.93 | -15.92* |
| | | | 160 | 171.43 | 162.16 | - 9.27* |
| | Post-test I | 80.55 | 100 | 114.29 | 97.56 | -16.73* |
| | | | 120 | 120.00 | 103.45 | -16.55* |
| | | | 140 | 144.58 | 144.58 | 0 |
| | | | 160 | 163.04 | 157.89 | - 5.15 |
| | Post-test II | 80.48 | 100 | 108.11 | 103.45 | - 4.66 |
| | | | 120 | 125.00 | 108.11 | -16.89* |
| | | | 140 | 151.90 | 129.03 | -22.87* |
| | | | 160 | 162.16 | 146.34 | -15.86* |
| RL | Pretest | 75.96 | 100 | 109.09 | 104.35 | - 4.74 |
| | | | 120 | 123.71 | 117.65 | - 6.06 |
| | | | 140 | 157.89 | 153.85 | - 4.04 |
| | | | 160 | 166.67 | 171.43 | + 4.76 |
| | Post-test I | 63.01 | 100 | 105.26 | 96.00 | - 9.26* |
| | | | 120 | 125.00 | 113.21 | -11.79* |
| | | | 140 | 148.05 | 133.33 | -14.72* |
| | | | 160 | 171.43 | 157.89 | -13.54* |
| | Post-test II | 58.87 | 100 | 100.77 | 93.55 | - 7.22* |
| | | | 120 | 125.00 | 103.45 | -22.55* |
| | | | 140 | 141.18 | 129.03 | -12.15* |
| | | | 160 | 166.67 | 153.85 | -12.82* |

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| DM | Pretest | 88.29 | 100 | 105.26 | 106.19 | + 0.93 |
| | | | 120 | 127.66 | 125.00 | - 2.66 |
| | | | 140 | 148.05 | 137.93 | -10.12* |
| | | | 160 | 164.38 | 166.67 | + 2.29 |
| | Post-test I | 75.09 | 100 | 106.19 | 96.77 | - 9.42* |
| | | | 120 | 125.00 | 125.00 | 0 |
| | | | 140 | 150.00 | 148.15 | - 1.85 |
| | | | 160 | 160.89 | 154.90 | - 5.99 |
| | Post-test II | 76.35 | 100 | 117.65 | 106.19 | -11.46* |
| | | | 120 | 133.33 | 110.09 | -23.24* |
| | | | 140 | 144.84 | 137.89 | - 6.95 |
| | | | 160 | 160.00 | 136.99 | -23.01* |
| KN | Pretest | 82.83 | 100 | 102.56 | 100.84 | - 1.72 |
| | | | 120 | 125.00 | 120.00 | - 5.00 |
| | | | 140 | 144.58 | 136.36 | - 8.22 |
| | | | 160 | 162.16 | 166.67 | + 4.51 |
| | Post-test I | 61.45 | 100 | 107.14 | 100.00 | - 7.14* |
| | | | 120 | 125.00 | 120.00 | - 5.00 |
| | | | 140 | 142.86 | 137.93 | - 4.94 |
| | | | 160 | 160.89 | 151.05 | - 9.84* |
| | Post-test II | 77.06 | 100 | 107.14 | 100.00 | - 3.14 |
| | | | 120 | 126.32 | 126.32 | 0 |
| | | | 140 | 148.05 | 142.86 | - 5.19 |
| | | | 160 | 160.89 | 160.89 | 0 |
| PP | Pretest | 87.33 | 100 | 112.15 | 105.26 | - 6.89 |
| | | | 120 | 120.00 | 117.65 | - 2.35 |
| | | | 140 | 142.86 | 139.53 | - 3.33 |
| | | | 160 | 166.67 | 166.67 | 0 |
| | Post-test I | 73.17 | 100 | 105.26 | 96.77 | - 8.49* |
| | | | 120 | 125.00 | 102.56 | -22.44* |
| | | | 140 | 140.36 | 133.03 | - 7.33* |
| | | | 160 | 166.67 | 160.00 | - 6.67 |
| | Post-test II | 59.73 | 100 | 101.69 | 90.23 | -21.46* |
| | | | 120 | 122.45 | 101.69 | -20.76* |
| | | | 140 | 146.34 | 133.33 | -13.01* |
| | | | 160 | 162.16 | 157.89 | - 4.27 |

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| KP | Pretest | 81.83 | 100 | 109.09 | 109.09 | 0 |
| | | | 120 | 120.00 | 125.00 | + 5.00 |
| | | | 140 | 153.85 | 136.36 | -17.49* |
| | | | 160 | 176.47 | 190.48 | +14.01 |
| | Post-test I | 61.67 | 100 | 115.38 | 120.00 | + 4.62 |
| | | | 120 | 134.83 | 129.03 | - 5.80 |
| | | | 140 | 141.18 | 131.87 | - 9.31* |
| | | | 160 | 166.67 | 160.00 | - 6.67* |
| | Post-test II | 60.23 | 100 | 105.26 | 103.45 | - 1.81 |
| | | | 120 | 129.03 | 123.71 | - 5.32 |
| | | | 140 | 150.00 | 144.58 | - 5.42 |
| | | | 160 | 160.89 | 154.90 | - 5.99 |
| MS | Pretest | 70.09 | 100 | 100.00 | 92.31 | - 7.69* |
| | | | 120 | 122.45 | 118.18 | - 3.64 |
| | | | 140 | 146.34 | 153.85 | + 7.51 |
| | | | 160 | 160.00 | 162.16 | + 2.16 |
| | Post-test I | 62.78 | 100 | 103.45 | 107.14 | + 3.69 |
| | | | 120 | 120.38 | 100.00 | -20.38* |
| | | | 140 | 157.89 | 146.34 | -11.55* |
| | | | 160 | 179.10 | 162.16 | -16.94* |
| | Post-test II | 63.81 | 100 | 105.26 | 100.00 | - 5.26 |
| | | | 120 | 121.11 | 110.00 | -10.11* |
| | | | 140 | 150.00 | 141.18 | - 8.82* |
| | | | 160 | 166.67 | 139.53 | -27.14* |
| KS | Pretest | 93.49 | 100 | 107.14 | 107.14 | 0 |
| | | | 120 | 123.71 | 125.00 | + 1.29 |
| | | | 140 | 153.85 | 157.89 | + 4.04 |
| | | | 160 | 171.43 | 169.01 | - 2.42 |
| | Post-test I | 78.42 | 100 | 117.65 | 98.36 | -19.29* |
| | | | 120 | 121.21 | 107.14 | -14.07* |
| | | | 140 | 142.86 | 127.66 | -15.20* |
| | | | 160 | 160.00 | 153.85 | - 6.15 |
| | Post-test II | 69.32 | 100 | 105.26 | 99.17 | - 6.09 |
| | | | 120 | 130.43 | 113.21 | -17.22* |
| | | | 140 | 151.90 | 150.00 | - 1.90 |
| | | | 160 | 160.84 | 155.55 | - 5.84 |

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| SW | Pretest | 107.21 | 100 | 100.00 | 90.91 | - 9.09 |
| | | | 120 | 122.45 | 118.81 | - 3.64 |
| | | | 140 | 140.36 | 137.33 | - 3.03 |
| | | | 160 | 164.38 | 171.43 | + 7.05 |
| | Post-test I | 88.38 | 100 | 113.21 | 92.31 | -20.90* |
| | | | 120 | 130.43 | 111.11 | -19.32* |
| | | | 140 | 155.84 | 134.83 | -21.01* |
| | | | 160 | 162.16 | 142.86 | -19.30* |
| | Post-test II | 104.38 | 100 | 113.21 | 103.45 | - 9.76 |
| | | | 120 | 120.00 | 103.45 | -16.55* |
| | | | 140 | 146.67 | 124.58 | -22.09* |
| | | | 160 | 162.16 | 146.34 | -15.82* |

RAW DATA FOR HEART RATE LOWERING
DURING EXERCISE STRESS

Experimental Group II - Delayed Feedback

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| BJA | Pretest | 90.96 | 100 | 101.69 | 100.00 | - 1.69 |
| | | | 120 | 122.45 | 123.71 | + 1.26 |
| | | | 140 | 142.86 | 131.87 | -10.99* |
| | | | 160 | 166.67 | 162.16 | - 4.51 |
| | Post-test I | 82.97 | 100 | 103.99 | 94.49 | - 9.50* |
| | | | 120 | 121.21 | 120.00 | - 1.21 |
| | | | 140 | 142.86 | 139.53 | - 3.33 |
| | | | 160 | 164.38 | 157.89 | - 6.49 |
| | Post-test II | 80.24 | 100 | 107.14 | 96.77 | -10.37* |
| | | | 120 | 123.71 | 113.21 | -10.50* |
| | | | 140 | 141.18 | 136.36 | - 4.82 |
| | | | 160 | 162.16 | 153.85 | - 8.31* |
| MAB | Pretest | 77.67 | 100 | 100.77 | 93.55 | - 7.22 |
| | | | 120 | 127.66 | 111.11 | -16.55* |
| | | | 140 | 150.00 | 130.43 | -19.57* |
| | | | 160 | 162.16 | 162.16 | 0 |
| | Post-test I | 77.73 | 100 | 101.69 | 99.17 | - 3.52 |
| | | | 120 | 127.66 | 122.45 | - 5.21 |
| | | | 140 | 150.00 | 142.86 | - 7.14 |
| | | | 160 | 169.01 | 157.89 | -11.12* |
| | Post-test II | 80.44 | 100 | 109.09 | 100.84 | - 8.25* |
| | | | 120 | 123.71 | 117.65 | - 6.06 |
| | | | 140 | 140.36 | 134.43 | - 5.93 |
| | | | 160 | 164.38 | 152.87 | -11.51* |

* $\leq$ ten per cent of the resting heart rate

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| CB | Pretest | 75.67 | 100 | 107.14 | 107.14 | 0 |
| | | | 120 | 130.43 | 122.45 | - 7.98* |
| | | | 140 | 144.58 | 146.34 | + 1.76 |
| | | | 160 | 160.89 | 174.43 | +13.54 |
| | Post-test I | 67.30 | 100 | 115.38 | 109.09 | - 6.29 |
| | | | 120 | 126.32 | 125.00 | - 1.32 |
| | | | 140 | 148.05 | 139.53 | - 8.52* |
| | | | 160 | 166.67 | 157.89 | - 8.78* |
| | Post-test II | 67.30 | 100 | 115.38 | 103.45 | -11.95* |
| | | | 120 | 133.33 | 120.00 | -13.33* |
| | | | 140 | 150.00 | 130.43 | -19.57* |
| | | | 160 | 160.00 | 157.89 | - 2.11 |
| CE | Pretest | 81.83 | 100 | 109.09 | 107.14 | - 1.95 |
| | | | 120 | 122.45 | 113.21 | - 9.24* |
| | | | 140 | 140.36 | 141.93 | + 1.57 |
| | | | 160 | 160.00 | 160.00 | 0 |
| | Post-test I | 69.28 | 100 | 107.14 | 107.14 | 0 |
| | | | 120 | 133.33 | 109.09 | -24.24* |
| | | | 140 | 141.18 | 133.33 | - 7.85* |
| | | | 160 | 160.00 | 150.00 | -10.00* |
| | Post-test II | 78.80 | 100 | 107.14 | 103.45 | - 2.69 |
| | | | 120 | 127.66 | 115.38 | -12.28* |
| | | | 140 | 142.86 | 136.36 | -14.50* |
| | | | 160 | 162.16 | 153.85 | - 8.31* |
| CH | Pretest | 109.59 | 100 | 111.11 | 104.35 | - 6.76 |
| | | | 120 | 125.00 | 142.86 | +17.86 |
| | | | 140 | 146.34 | 150.00 | + 3.66 |
| | | | 160 | 164.38 | 164.38 | 0 |
| | Post-test I | 81.55 | 100 | 111.11 | 89.55 | -21.56* |
| | | | 120 | 120.65 | 110.14 | -10.51* |
| | | | 140 | 146.34 | 142.86 | - 3.48 |
| | | | 160 | 162.16 | 155.84 | - 6.32 |
| | Post-test II | 84.59 | 100 | 107.14 | 111.11 | + 3.48 |
| | | | 120 | 125.00 | 127.66 | + 2.66 |
| | | | 140 | 141.18 | 136.36 | - 4.82 |
| | | | 160 | 162.16 | 153.85 | - 8.31 |

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| DL | Pretest | 84.11 | 100 | 106.19 | 111.11 | + 4.92 |
| | | | 120 | 130.83 | 136.36 | + 5.53 |
| | | | 140 | 146.34 | 144.58 | - 1.76 |
| | | | 160 | 164.38 | 166.67 | + 2.29 |
| | Post-test I | 75.67 | 100 | 116.50 | 111.11 | - 5.39 |
| | | | 120 | 120.38 | 106.69 | -13.69* |
| | | | 140 | 140.93 | 114.29 | -26.64* |
| | | | 160 | 164.38 | 146.34 | -18.04* |
| | Post-test II | 86.55 | 100 | 113.21 | 105.26 | - 7.95 |
| | | | 120 | 123.71 | 123.71 | 0 |
| | | | 140 | 144.58 | 125.00 | -19.58* |
| | | | 160 | 164.38 | 142.86 | -21.52* |
| DM | Pretest | 67.79 | 100 | 103.45 | 109.09 | + 5.64 |
| | | | 120 | 125.00 | 125.00 | 0 |
| | | | 140 | 142.86 | 141.18 | - 1.68 |
| | | | 160 | 169.01 | 162.16 | - 6.85* |
| | Post-test I | 65.73 | 100 | 108.11 | 107.14 | - 0.97 |
| | | | 120 | 120.00 | 117.65 | - 2.35 |
| | | | 140 | 141.18 | 139.53 | - 1.65 |
| | | | 160 | 160.00 | 162.16 | + 2.16 |
| | Post-test II | 61.44 | 100 | 101.96 | 110.24 | + 8.28 |
| | | | 120 | 122.45 | 120.00 | - 2.45 |
| | | | 140 | 141.18 | 142.86 | + 1.68 |
| | | | 160 | 163.85 | 173.67 | + 6.82 |
| SR | Pretest | 94.31 | 100 | 104.35 | 104.35 | 0 |
| | | | 120 | 120.50 | 111.14 | - 9.36 |
| | | | 140 | 142.86 | 139.53 | - 3.33 |
| | | | 160 | 166.67 | 166.67 | 0 |
| | Post-test I | 69.05 | 100 | 117.65 | 103.45 | -14.20* |
| | | | 120 | 121.21 | 117.65 | - 3.56 |
| | | | 140 | 142.86 | 134.83 | - 8.03* |
| | | | 160 | 162.16 | 157.89 | - 4.27 |
| | Post-test II | 84.00 | 100 | 111.11 | 109.09 | - 2.02 |
| | | | 120 | 122.45 | 127.66 | + 5.21 |
| | | | 140 | 146.34 | 146.34 | 0 |
| | | | 160 | 162.16 | 160.00 | - 2.16 |

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| AS | Pretest | 74.46 | 100 | 103.45 | 95.24 | - 8.21* |
| | | | 120 | 125.00 | 125.00 | 0 |
| | | | 140 | 146.34 | 139.53 | - 6.81 |
| | | | 160 | 160.00 | 172.16 | +12.16 |
| | Post-test I | 83.73 | 100 | 100.17 | 102.69 | + 2.52 |
| | | | 120 | 123.71 | 114.29 | - 9.42* |
| | | | 140 | 146.34 | 136.36 | - 9.98* |
| | | | 160 | 164.38 | 142.86 | -21.52* |
| | Post-test II | 66.07 | 100 | 101.69 | 98.36 | - 3.33 |
| | | | 120 | 125.00 | 112.15 | -12.85* |
| | | | 140 | 150.00 | 133.33 | -16.67* |
| | | | 160 | 157.89 | 137.93 | -19.96* |

## RAW DATA FOR HEART RATE LOWERING DURING EXERCISE STRESS

Control Group - No Conditioning

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| JB | Pretest | 96.36 | 100 | 105.26 | 103.45 | - 1.81 |
| | | | 120 | 118.81 | 117.65 | - 1.16 |
| | | | 140 | 144.58 | 146.34 | + 1.76 |
| | | | 160 | 162.16 | 166.67 | + 4.51 |
| | Post-test I | 64.83 | 100 | 106.19 | 103.45 | - 2.74 |
| | | | 120 | 120.81 | 122.00 | + 1.19 |
| | | | 140 | 140.53 | 142.18 | - 1.65 |
| | | | 160 | 160.00 | 157.89 | - 2.11 |
| | Post-test II | 86.20 | 100 | 111.11 | 109.09 | - 2.02 |
| | | | 120 | 123.71 | 122.45 | - 1.26 |
| | | | 140 | 155.84 | 153.85 | - 1.99 |
| | | | 160 | 164.38 | .62.16 | - 2.22 |
| CC | Pretest | 95.89 | 100 | 100.84 | 105.26 | + 4.42 |
| | | | 120 | 122.45 | 130.43 | + 7.98 |
| | | | 140 | 146.34 | 142.86 | - 3.48 |
| | | | 160 | 160.00 | 166.67 | + 6.67 |
| | Post-test I | 84.54 | 100 | 100.00 | 104.35 | + 4.35 |
| | | | 120 | 127.66 | 122.45 | - 5.21 |
| | | | 140 | 157.89 | 153.85 | - 4.04 |
| | | | 160 | 166.67 | 160.00 | - 6.67 |
| | Post-test II | 90.12 | 100 | 106.19 | 98.36 | - 7.83 |
| | | | 120 | 127.66 | 126.32 | - 1.34 |
| | | | 140 | 150.00 | 160.00 | +10.00 |
| | | | 160 | 171.43 | 153.83 | -17.60* |

* $\leq$ ten per cent of the resting heart rate

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| AG | Pretest | 82.49 | 100 | 112.15 | 105.26 | - 6.89 |
| | | | 120 | 120.00 | 107.14 | -12.86* |
| | | | 140 | 142.86 | 133.33 | -19.53* |
| | | | 160 | 176.47 | 162.16 | -14.31* |
| | Post-test I | 91.87 | 100 | 111.11 | 113.21 | + 2.10 |
| | | | 120 | 126.32 | 123.71 | - 2.61 |
| | | | 140 | 146.34 | 150.00 | + 3.66 |
| | | | 160 | 162.16 | 167.83 | + 5.67 |
| | Post-test II | 81.21 | 100 | 106.19 | 113.21 | + 7.02 |
| | | | 120 | 139.53 | 133.33 | - 6.20 |
| | | | 140 | 144.58 | 144.58 | 0 |
| | | | 160 | 160.00 | 162.16 | + 2.16 |
| SM | Pretest | 82.97 | 100 | 109.09 | 111.11 | + 2.02 |
| | | | 120 | 120.00 | 139.53 | +19.53 |
| | | | 140 | 148.05 | 150.00 | + 1.95 |
| | | | 160 | 164.38 | 160.00 | - 4.38 |
| | Post-test I | 82.99 | 100 | 109.09 | 86.96 | -22.13* |
| | | | 120 | 122.45 | 125.00 | + 2.55 |
| | | | 140 | 150.00 | 141.18 | - 8.82* |
| | | | 160 | 169.01 | 160.00 | - 9.01* |
| | Post-test II | 67.31 | 100 | 110.09 | 112.15 | + 2.06 |
| | | | 120 | 120.00 | 121.21 | + 1.21 |
| | | | 140 | 146.34 | 150.00 | + 3.66 |
| | | | 160 | 160.00 | 160.00 | 0 |
| GM | Pretest | 83.90 | 100 | 103.45 | 107.14 | + 3.69 |
| | | | 120 | 120.00 | 127.66 | + 7.66 |
| | | | 140 | 142.86 | 137.93 | - 4.93 |
| | | | 160 | 162.16 | 155.84 | - 6.32 |
| | Post-test I | 80.89 | 100 | 110.09 | 107.14 | - 2.95 |
| | | | 120 | 122.45 | 125.00 | + 2.55 |
| | | | 140 | 144.58 | 142.86 | - 1.72 |
| | | | 160 | 160.00 | 166.67 | + 6.67 |
| | Post-test II | 91.17 | 100 | 107.14 | 113.21 | + 6.07 |
| | | | 120 | 120.50 | 124.00 | + 3.50 |
| | | | 140 | 140.53 | 151.00 | +10.47 |
| | | | 160 | 162.16 | 160.00 | - 2.16 |

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| EP | Pretest | 82.66 | 100 | 111.11 | 90.91 | -10.20* |
| | | | 120 | 125.00 | 125.00 | 0 |
| | | | 140 | 141.18 | 139.53 | - 1.65 |
| | | | 160 | 162.16 | 162.16 | 0 |
| | Post-test I | 81.24 | 100 | 111.11 | 105.26 | - 5.85 |
| | | | 120 | 123.71 | 123.71 | 0 |
| | | | 140 | 142.86 | 141.18 | - 1.68 |
| | | | 160 | 160.89 | 158.84 | - 2.04 |
| | Post-test II | 87.27 | 100 | 110.09 | 111.11 | + 1.02 |
| | | | 120 | 127.66 | 130.43 | + 2.77 |
| | | | 140 | 140.36 | 143.53 | + 3.17 |
| | | | 160 | 160.00 | 160.00 | 0 |
| JR | Pretest | 111.40 | 100 | 119.45 | 114.65 | - 4.80 |
| | | | 120 | 125.00 | 117.65 | - 7.35 |
| | | | 140 | 150.00 | 141.18 | - 8.82 |
| | | | 160 | 171.43 | 176.47 | + 5.04 |
| | Post-test I | 71.75 | 100 | 114.29 | 120.00 | + 5.71 |
| | | | 120 | 126.32 | 121.21 | + 5.11 |
| | | | 140 | 142.86 | 137.93 | - 4.93 |
| | | | 160 | 164.38 | 157.89 | - 6.49 |
| | Post-test II | 87.99 | 100 | 100.36 | 111.09 | +10.73 |
| | | | 120 | 122.45 | 117.65 | - 4.80 |
| | | | 140 | 150.00 | 148.05 | - 1.95 |
| | | | 160 | 162.16 | 164.38 | + 2.22 |
| LR | Pretest | 96.28 | 100 | 109.09 | 104.35 | - 4.74 |
| | | | 120 | 120.00 | 134.83 | +14.83 |
| | | | 140 | 142.86 | 146.34 | + 3.48 |
| | | | 160 | 164.38 | 160.00 | - 4.38 |
| | Post-test I | 88.00 | 100 | 107.14 | 105.67 | - 1.47 |
| | | | 120 | 122.45 | 131.76 | + 9.31 |
| | | | 140 | 148.05 | 147.21 | - 0.84 |
| | | | 160 | 169.01 | 167.99 | - 1.02 |
| | Post-test II | 76.96 | 100 | 103.45 | 105.26 | + 1.81 |
| | | | 120 | 121.21 | 125.00 | + 3.79 |
| | | | 140 | 146.34 | 141.18 | - 5.16 |
| | | | 160 | 166.67 | 169.01 | + 2.34 |

| Subject | Test | Resting Heart Rate | Level | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|
| LS | Pretest | 64.37 | 100 | 103.45 | 110.09 | + 6.64 |
| | | | 120 | 122.45 | 122.45 | 0 |
| | | | 140 | 146.34 | 142.86 | - 3.48 |
| | | | 160 | 171.43 | 160.00 | -11.43* |
| | Post-test I | 52.83 | 100 | 107.14 | 105.26 | - 1.88 |
| | | | 120 | 120.65 | 118.38 | - 2.27 |
| | | | 140 | 141.18 | 136.36 | - 4.82 |
| | | | 160 | 160.84 | 165.00 | + 5.84 |
| | Post-test II | 59.26 | 100 | 106.26 | 104.35 | - 1.91 |
| | | | 120 | 120.00 | 117.65 | - 2.35 |
| | | | 140 | 144.58 | 148.05 | + 3.47 |
| | | | 160 | 160.89 | 163.00 | + 2.11 |
| SB | Pretest | 81.15 | 100 | 105.26 | 101.69 | - 3.57 |
| | | | 120 | 122.45 | 122.45 | 0 |
| | | | 140 | 142.86 | 141.18 | - 1.68 |
| | | | 160 | 162.16 | 171.43 | + 9.27 |
| | Post-test I | 84.92 | 100 | 101.69 | 99.17 | - 2.52 |
| | | | 120 | 125.00 | 122.45 | - 2 55 |
| | | | 140 | 148.05 | 139.53 | - 8.52* |
| | | | 160 | 160.00 | 153.85 | - 6.15 |
| | Post-test II | 77.67 | 100 | 105.26 | 104.35 | - 0.91 |
| | | | 120 | 126.32 | 120.00 | - 6.32 |
| | | | 140 | 140.93 | 136.36 | - 4.57 |
| | | | 160 | 160.00 | 157.89 | - 2.11 |
| PW | Pretest | 74.14 | 100 | 103.45 | 103.45 | 0 |
| | | | 120 | 120.00 | 111.11 | - 8.89* |
| | | | 140 | 146.34 | 144.58 | - 1.76 |
| | | | 160 | 166.67 | 169.01 | + 2.34 |
| | Post-test I | 77.61 | 100 | 100.17 | 96.24 | - 3.93 |
| | | | 120 | 122.45 | 123.71 | + 1.26 |
| | | | 140 | 150.00 | 150.75 | + 0.75 |
| | | | 160 | 162.16 | 169.01 | + 6.85 |
| | Post-test II | 74.57 | 100 | 103.45 | 104.35 | + 0.90 |
| | | | 120 | 121.21 | 126.32 | + 5.11 |
| | | | 140 | 141.18 | 144.58 | + 3.40 |
| | | | 160 | 164.38 | 171.43 | + 7.05 |

RAW DATA FOR INSTRUMENTAL CONDITIONING PERIOD
EXPERIMENTAL GROUP I--IMMEDIATE FEEDBACK

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| MA | 1 | 80.97 | 8.10 | 1 | 81.08 | 76.92 | - 4.16 |
| | | | | 2 | 83.33 | 71.43 | -11.90* |
| | | | | 3 | 83.33 | 78.95 | - 4.38 |
| | | | | 4 | 81.08 | 76.92 | - 4.14 |
| | 2 | 87.58 | 8.76 | 1 | 92.31 | 83.33 | - 8.98* |
| | | | | 2 | 85.71 | 82.19 | - 3.52 |
| | | | | 3 | 89.55 | 88.24 | - 1.31 |
| | | | | 4 | 88.24 | 85.71 | - 2.53 |
| | 3 | 87.22 | 8.72 | 1 | 82.19 | 75.95 | - 6.18 |
| | | | | 2 | 84.51 | 78.95 | - 5.56 |
| | | | | 3 | 92.31 | 78.95 | -13.36* |
| | | | | 4 | 86.96 | 85.71 | - 1.25 |
| | 4 | 93.22 | 9.32 | 1 | 103.45 | 76.92 | -26.53* |
| | | | | 2 | 92.38 | 83.33 | - 8.98 |
| | | | | 3 | 92.31 | 81.08 | -11.23* |
| | | | | 4 | 95.24 | 84.51 | -10.73* |
| | 5 | 76.02 | 7.60 | 1 | 76.92 | 77.92 | + 1.00 |
| | | | | 2 | 75.95 | 75.95 | 0 |
| | | | | 3 | 75.00 | 75.00 | 0 |
| | | | | 4 | 81.08 | 73.17 | - 9.81* |
| | 6 | 94.69 | 9.47 | 1 | 90.91 | 90.91 | 0 |
| | | | | 2 | 98.36 | 82.19 | -16.17* |
| | | | | 3 | 103.45 | 90.91 | -12.54* |
| | | | | 4 | 96.77 | 86.96 | - 9.81* |
| | 7 | 85.85 | 8.59 | 1 | 103.45 | 80.00 | -23.45* |
| | | | | 2 | 82.19 | 78.95 | - 3.24 |
| | | | | 3 | 85.71 | 83.33 | - 2.38 |
| | | | | 4 | 81.08 | 78.95 | - 2.13 |
| | 8 | 86.50 | 8.65 | 1 | 75.00 | 75.00 | 0 |
| | | | | 2 | 88.24 | 72.29 | -15.95* |
| | | | | 3 | 107.14 | 72.29 | -34.85* |
| | | | | 4 | 90.91 | 70.59 | -20.32* |
| | 9 | 95.53 | 9.55 | 1 | 100.00 | 89.55 | -10.45* |
| | | | | 2 | 105.26 | 89.55 | -15.71* |
| | | | | 3 | 95.24 | 84.51 | -10.73* |
| | | | | 4 | 107.14 | 96.77 | -10.37* |
| | 10 | 107.84 | 10.78 | 1 | 103.45 | 96.77 | - 6.68 |
| | | | | 2 | 111.11 | 98.77 | -12.75* |
| | | | | 3 | 115.38 | 93.75 | -21.63* |
| | | | | 4 | 107.14 | 93.75 | -13.39* |

* ≤ to 10% decrement

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| BB | 1 | 70.88 | 7.09 | 1 | 66.67 | 63.83 | - 2.84 |
| | | | | 2 | 76.92 | 63.83 | -13.09* |
| | | | | 3 | 61.22 | 62.50 | + 1.28 |
| | | | | 4 | 75.00 | 63.83 | -11.17* |
| | 2 | 68.16 | 6.82 | 1 | 58.25 | 58.82 | + 0.57 |
| | | | | 2 | 66.67 | 60.00 | - 6.67 |
| | | | | 3 | 60.61 | 61.22 | + 0.61 |
| | | | | 4 | 63.83 | 60.00 | - 3.83 |
| | 3 | 84.92 | 8.49 | 1 | 81.08 | 81.08 | 0 |
| | | | | 2 | 89.55 | 83.33 | - 6.22 |
| | | | | 3 | 95.24 | 77.92 | -17.32* |
| | | | | 4 | 81.08 | 81.08 | 0 |
| | 4 | 94.36 | 9.44 | 1 | 100.00 | 89.55 | -10.45* |
| | | | | 2 | 93.75 | 84.51 | - 9.24 |
| | | | | 3 | 90.91 | 84.51 | - 6.40 |
| | | | | 4 | 96.77 | 83.33 | -13.44* |
| | 5 | 93.90 | 9.39 | 1 | 92.31 | 88.24 | - 4.07 |
| | | | | 2 | 93.75 | 81.08 | -12.67* |
| | | | | 3 | 92.31 | 85.71 | - 6.60 |
| | | | | 4 | 89.55 | 81.08 | - 8.47 |
| | 6 | 82.99 | 8.30 | 1 | 96.77 | 85.71 | -11.06* |
| | | | | 2 | 88.24 | 80.00 | - 8.24 |
| | | | | 3 | 88.24 | 77.92 | -10.32* |
| | | | | 4 | 95.24 | 81.08 | -14.16* |
| | 7 | 86.98 | 8.70 | 1 | 95.24 | 85.71 | - 9.53* |
| | | | | 2 | 88.24 | 76.92 | -11.32* |
| | | | | 3 | 89.55 | 76.92 | -12.63* |
| | | | | 4 | 96.77 | 75.00 | -21.77* |
| | 8 | 86.65 | 8.67 | 1 | 90.91 | 81.08 | - 9.83* |
| | | | | 2 | 88.24 | 78.95 | - 9.29* |
| | | | | 3 | 86.96 | 76.92 | -10.04* |
| | | | | 4 | 90.91 | 76.92 | -13.99* |
| | 9 | [illegible]4.25 | 8.43 | 1 | 92.31 | 83.33 | - 8.99* |
| | | | | 2 | 85.71 | 75.00 | -10.71* |
| | | | | 3 | 96.77 | 80.00 | -16.77* |
| | | | | 4 | 85.71 | 76.95 | - 8.76* |
| | 10 | 88.94 | 8.89 | 1 | 96.77 | 84.51 | -12.26* |
| | | | | 2 | 90.91 | 81.08 | - 9.83* |
| | | | | 3 | 90.91 | 76.92 | -13.99* |
| | | | | 4 | 84.51 | 81.08 | - 3.43 |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| SD | 1 | 60.06 | 6.01 | 1 | 60.00 | 58.82 | - 1.18 |
| | | | | 2 | 50.00 | 53.57 | + 3.57 |
| | | | | 3 | 53.57 | 51.72 | - 1.85 |
| | | | | 4 | 58.82 | 55.56 | - 3.26 |
| | 2 | 72.59 | 7.26 | 1 | 71.43 | 58.82 | -12.61* |
| | | | | 2 | 55.56 | 63.83 | + 8.27 |
| | | | | 3 | 63.16 | 58.84 | - 4.34 |
| | | | | 4 | 57.69 | 54.55 | - 3.14 |
| | 3 | 61.85 | 6.19 | 1 | 61.86 | 57.69 | - 4.17 |
| | | | | 2 | 52.63 | 55.56 | + 2.93 |
| | | | | 3 | 61.22 | 55.56 | - 5.66 |
| | | | | 4 | 70.59 | 58.25 | -12.34* |
| | 4 | 68.26 | 6.83 | 1 | 69.77 | 63.16 | - 6.51 |
| | | | | 2 | 81.08 | 68.18 | -12.90* |
| | | | | 3 | 80.00 | 65.22 | -14.78* |
| | | | | 4 | 70.59 | 66.67 | - 3.92 |
| | 5 | 67.42 | 6.74 | 1 | 74.07 | 55.56 | -18.51* |
| | | | | 2 | 81.08 | 54.55 | -26.53* |
| | | | | 3 | 58.82 | 58.82 | 0 |
| | | | | 4 | 73.17 | 51.72 | -21.45* |
| | 6 | 67.28 | 6.73 | 1 | 63.83 | 63.16 | - 0.67 |
| | | | | 2 | 75.00 | 66.67 | - 8.33* |
| | | | | 3 | 83.33 | 63.83 | -19.50* |
| | | | | 4 | 75.95 | 60.00 | -15.95* |
| | 7 | 61.12 | 6.11 | 1 | 60.00 | 52.17 | - 7.83* |
| | | | | 2 | 65.22 | 52.17 | -13.05* |
| | | | | 3 | 76.92 | 57.14 | -19.78* |
| | | | | 4 | 78.95 | 54.05 | -23.90* |
| | 8 | 55.79 | 5.58 | 1 | 53.10 | 50.00 | - 3.10 |
| | | | | 2 | 68.18 | 55.05 | -13.13* |
| | | | | 3 | 51.72 | 50.00 | - 1.72 |
| | | | | 4 | 68.18 | 55.56 | -12.62* |
| | 9 | 76.59 | 7.66 | 1 | 88.24 | 73.17 | -15.07* |
| | | | | 2 | 75.00 | 66.67 | - 8.33* |
| | | | | 3 | 72.29 | 65.93 | - 6.36 |
| | | | | 4 | 76.92 | 58.82 | -18.10* |
| | 10 | 47.63 | 4.76 | 1 | 66.67 | 48.39 | -18.28* |
| | | | | 2 | 65.22 | 52.63 | -12.59* |
| | | | | 3 | 57.69 | 47.24 | -10.44* |
| | | | | 4 | 54.05 | 50.00 | - 4.05 |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| SF | 1 | 92.79 | 9.28 | 1 | 93.75 | 90.91 | - 2.84 |
| | | | | 2 | 93.75 | 90.91 | - 2.84 |
| | | | | 3 | 93.75 | 83.33 | -10.42* |
| | | | | 4 | 98.36 | 89.55 | - 8.81 |
| | 2 | 86.97 | 8.70 | 1 | 88.24 | 81.08 | - 7.16 |
| | | | | 2 | 93.75 | 83.33 | -10.42* |
| | | | | 3 | 86.96 | 83.33 | - 3.63 |
| | | | | 4 | 90.91 | 78.95 | -11.96* |
| | 3 | 95.86 | 9.59 | 1 | 96.77 | 86.96 | - 9.81* |
| | | | | 2 | 88.24 | 92.31 | + 4.07 |
| | | | | 3 | 96.77 | 90.91 | - 5.86 |
| | | | | 4 | 90.91 | 92.31 | + 1.40 |
| | 4 | 83.77 | 8.38 | 1 | 100.00 | 81.08 | -18.92* |
| | | | | 2 | 82.19 | 78.95 | - 3.24 |
| | | | | 3 | 90.91 | 71.43 | -19.48* |
| | | | | 4 | 83.33 | 77.92 | - 5.41 |
| | 5 | 95.76 | 9.58 | 1 | 101.69 | 85.71 | -15.98* |
| | | | | 2 | 93.75 | 86.96 | - 6.70 |
| | | | | 3 | 89.55 | 89.55 | 0 |
| | | | | 4 | 96.77 | 83.33 | -13.44* |
| | 6 | 86.85 | 8.69 | 1 | 83.33 | 74.07 | - 9.26* |
| | | | | 2 | 88.24 | 78.95 | - 9.29* |
| | | | | 3 | 89.55 | 80.00 | - 9.55* |
| | | | | 4 | 88.24 | 83.33 | - 4.91 |
| | 7 | 85.86 | 8.59 | 1 | 92.31 | 83.33 | - 8.98* |
| | | | | 2 | 93.75 | 83.33 | -10.42* |
| | | | | 3 | 86.96 | 80.00 | - 6.96 |
| | | | | 4 | 92.31 | 83.33 | - 8.98* |
| | 8 | 87.55 | 8.76 | 1 | 85.71 | 75.95 | - 9.76* |
| | | | | 2 | 86.96 | 75.95 | -11.01* |
| | | | | 3 | 89.55 | 77.92 | -11.63* |
| | | | | 4 | 85.71 | 76.92 | - 8.79* |
| | 9 | 78.10 | 7.81 | 1 | 85.71 | 71.43 | -14.28* |
| | | | | 2 | 90.91 | 71.43 | -19.48* |
| | | | | 3 | 76.92 | 73.17 | - 3.75 |
| | | | | 4 | 78.95 | 68.97 | - 9.98* |
| | 10 | 84.59 | 8.46 | 1 | 83.33 | 77.92 | - 5.41 |
| | | | | 2 | 85.71 | 78.95 | - 6.76 |
| | | | | 3 | 85.71 | 80.00 | - 5.71 |
| | | | | 4 | 89.55 | 81.08 | - 8.47* |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| TH | 1 | 93.75 | 9.38 | 1 | 90.91 | 83.33 | - 7.58 |
| | | | | 2 | 85.71 | 83.33 | - 2.38 |
| | | | | 3 | 90.91 | 81.08 | - 9.83* |
| | | | | 4 | 88.24 | 78.95 | - 9.29 |
| | 2 | 79.80 | 7.98 | 1 | 84.51 | 75.00 | - 9.51* |
| | | | | 2 | 83.33 | 78.95 | - 4.38 |
| | | | | 3 | 85.71 | 78.95 | - 6.76 |
| | | | | 4 | 83.33 | 76.92 | - 6.41 |
| | 3 | 84.29 | 8.43 | 1 | 78.95 | 73.17 | - 6.78 |
| | | | | 2 | 96.77 | 76.92 | -19.85* |
| | | | | 3 | 83.33 | 78.95 | - 4.38 |
| | | | | 4 | 78.95 | 75.00 | - 3.95 |
| | 4 | 95.25 | 9.53 | 1 | 92.31 | 81.08 | -11.23* |
| | | | | 2 | 93.75 | 81.08 | -12.67* |
| | | | | 3 | 93.75 | 83.33 | -10.42* |
| | | | | 4 | 90.91 | 81.08 | - 9.83* |
| | 5 | 88.67 | 8.87 | 1 | 81.08 | 83.33 | + 2.25 |
| | | | | 2 | 83.33 | 78.95 | - 4.38 |
| | | | | 3 | 78.95 | 76.92 | - 2.03 |
| | | | | 4 | 86.96 | 82.19 | - 4.77 |
| | 6 | 86.09 | 8.61 | 1 | 90.91 | 77.92 | -12.99* |
| | | | | 2 | 92.31 | 78.95 | -13.36* |
| | | | | 3 | 88.24 | 78.95 | - 9.29* |
| | | | | 4 | 92.31 | 82.19 | -10.12* |
| | 7 | 85.88 | 8.59 | 1 | 95.24 | 78.95 | -16.29* |
| | | | | 2 | 93.75 | 81.08 | -12.67* |
| | | | | 3 | 93.75 | 76.92 | -16.83* |
| | | | | 4 | 84.51 | 76.92 | - 7.59 |
| | 8 | 74.31 | 7.43 | 1 | 82.19 | 74.07 | - 8.12* |
| | | | | 2 | 73.17 | 63.83 | - 9.34* |
| | | | | 3 | 77.92 | 64.52 | -13.40* |
| | | | | 4 | 81.08 | 68.18 | -12.90* |
| | 9 | 76.60 | 7.66 | 1 | 83.33 | 74.07 | - 9.26* |
| | | | | 2 | 83.33 | 73.17 | -10.16* |
| | | | | 3 | 88.24 | 75.00 | -13.24* |
| | | | | 4 | 76.92 | 75.00 | - 1.92 |
| | 10 | 79.21 | 7.92 | 1 | 92.31 | 75.00 | -17.31* |
| | | | | 2 | 88.24 | 75.00 | -13.24* |
| | | | | 3 | 83.33 | 69.77 | -13.56* |
| | | | | 4 | 88.24 | 73.17 | -15.07* |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| EH | 1 | 83.51 | 8.35 | 1 | 83.33 | 82.19 | - 1.14 |
| | | | | 2 | 81.08 | 86.96 | + 5.88 |
| | | | | 3 | 81.08 | 85.71 | + 4.63 |
| | | | | 4 | 85.71 | 89.55 | + 3.84 |
| | 2 | 79.37 | 7.94 | 1 | 83.33 | 76.92 | - 6.41 |
| | | | | 2 | 71.43 | 71.43 | 0 |
| | | | | 3 | 73.17 | 71.43 | + 1.74 |
| | | | | 4 | 78.95 | 71.43 | - 7.52 |
| | 3 | 92.54 | 9.25 | 1 | 86.96 | 75.00 | -11.96* |
| | | | | 2 | 90.91 | 83.33 | - 7.58 |
| | | | | 3 | 88.24 | 81.08 | - 7.16 |
| | | | | 4 | 90.91 | 82.19 | - 8.72 |
| | 4 | 96.84 | 9.68 | 1 | 103.45 | 81.08 | -22.37* |
| | | | | 2 | 89.55 | 80.00 | - 9.55 |
| | | | | 3 | 100.00 | 84.51 | -15.49* |
| | | | | 4 | 82.19 | 81.08 | - 1.08 |
| | 5 | 89.57 | 8.96 | 1 | 103.45 | 90.91 | -12.54* |
| | | | | 2 | 100.00 | 88.24 | -11.76* |
| | | | | 3 | 90.91 | 88.24 | - 2.67 |
| | | | | 4 | 90.91 | 88.24 | - 2.67 |
| | 6 | 94.84 | 9.48 | 1 | 103.45 | 89.55 | -13.90* |
| | | | | 2 | 89.55 | 88.24 | - 1.31 |
| | | | | 3 | 83.33 | 84.51 | + 1.18 |
| | | | | 4 | 96.77 | 88.24 | - 8.53 |
| | 7 | 87.11 | 8.71 | 1 | 98.36 | 88.24 | -10.12* |
| | | | | 2 | 85.71 | 83.33 | - 2.38 |
| | | | | 3 | 88.24 | 82.19 | - 6.05 |
| | | | | 4 | 85.71 | 81.08 | - 4.63 |
| | 8 | 100.07 | 10.01 | 1 | 105.26 | 95.24 | -10.02* |
| | | | | 2 | 101.69 | 90.91 | -10.78* |
| | | | | 3 | 100.00 | 85.71 | -14.29* |
| | | | | 4 | 96.77 | 89.55 | - 7.22 |
| | 9 | 99.00 | 9.90 | 1 | 92.31 | 88.24 | - 4.07 |
| | | | | 2 | 86.96 | 75.95 | -11.01* |
| | | | | 3 | 96.77 | 90.91 | - 5.86 |
| | | | | 4 | 89.55 | 78.95 | -10.61* |
| | 10 | 101.62 | 10.16 | 1 | 111.11 | 96.77 | -14.34* |
| | | | | 2 | 107.14 | 93.75 | -13.39* |
| | | | | 3 | 92.31 | 88.24 | - 4.07 |
| | | | | 4 | 93.75 | 85.71 | - 8.04 |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| MK | 1 | 97.04 | 9.70 | 1 | 107.14 | 90.91 | -16.23* |
| | | | | 2 | 81.08 | 88.24 | + 7.16 |
| | | | | 3 | 85.71 | 85.71 | 0 |
| | | | | 4 | 90.91 | 90.91 | 0 |
| | 2 | 107.19 | 10.72 | 1 | 96.77 | 90.91 | - 5.86 |
| | | | | 2 | 100.00 | 93.75 | - 6.25 |
| | | | | 3 | 101.69 | 88.24 | -13.45* |
| | | | | 4 | 90.91 | 93.75 | + 2.84 |
| | 3 | 80.41 | 8.04 | 1 | 78.95 | 75.00 | - 3.95 |
| | | | | 2 | 74.07 | 71.43 | - 2.64 |
| | | | | 3 | 85.71 | 76.92 | - 8.79* |
| | | | | 4 | 75.00 | 71.43 | - 3.57 |
| | 4 | 95.13 | 9.51 | 1 | 105.26 | 88.24 | -17.02* |
| | | | | 2 | 101.69 | 90.91 | -10.78* |
| | | | | 3 | 111.11 | 86.96 | -24.15* |
| | | | | 4 | 93.75 | 90.91 | - 2.84 |
| | 5 | 77.68 | 7.77 | 1 | 71.43 | 71.43 | 0 |
| | | | | 2 | 92.31 | 74.07 | -18.24* |
| | | | | 3 | 92.31 | 72.29 | -20.02* |
| | | | | 4 | 88.24 | 75.00 | -13.24 |
| | 6 | 80.13 | 8.01 | 1 | 93.75 | 73.17 | -20.58* |
| | | | | 2 | 76.92 | 74.07 | - 2.85 |
| | | | | 3 | 83.33 | 68.97 | -14.36* |
| | | | | 4 | 78.95 | 75.00 | - 3.95 |
| | 7 | 88.16 | 8.82 | 1 | 85.71 | 70.59 | -15.12* |
| | | | | 2 | 90.91 | 73.17 | -17.74* |
| | | | | 3 | 103.45 | 72.29 | -31.16* |
| | | | | 4 | 95.24 | 73.17 | -22.07* |
| | 8 | 85.36 | 8.54 | 1 | 100.00 | 68.18 | -31.82* |
| | | | | 2 | 83.33 | 73.17 | -10.16* |
| | | | | 3 | 86.96 | 69.77 | -17.19* |
| | | | | 4 | 78.95 | 75.00 | - 3.95 |
| | 9 | 88.44 | 8.84 | 1 | 75.00 | 76.92 | + 1.92 |
| | | | | 2 | 83.33 | 75.00 | -12.33* |
| | | | | 3 | 71.43 | 75.00 | + 4.43 |
| | | | | 4 | 88.24 | 71.43 | -16.81* |
| | 10 | 62.57 | 6.26 | 1 | 81.08 | 62.50 | -18.58* |
| | | | | 2 | 78.95 | 65.22 | -13.73* |
| | | | | 3 | 86.96 | 63.83 | -23.13* |
| | | | | 4 | 68.18 | 61.86 | - 6.32* |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| RL | 1 | 77.71 | 7.77 | 1 | 83.33 | 74.07 | - 9.26* |
| | | | | 2 | 74.07 | 69.77 | - 4.30 |
| | | | | 3 | 74.07 | 67.42 | - 6.65 |
| | | | | 4 | 75.95 | 71.43 | - 4.52 |
| | 2 | 60.85 | 6.09 | 1 | 68.97 | 54.05 | -14.92* |
| | | | | 2 | 63.83 | 58.82 | - 5.01 |
| | | | | 3 | 61.86 | 58.25 | - 3.61 |
| | | | | 4 | 57.69 | 52.63 | - 5.03 |
| | 3 | 68.48 | 6.85 | 1 | 71.43 | 61.22 | -10.21* |
| | | | | 2 | 71.43 | 64.52 | - 6.91* |
| | | | | 3 | 73.17 | 60.00 | -13.17* |
| | | | | 4 | 83.33 | 63.16 | -20.17* |
| | 4 | 81.51 | 8.15 | 1 | 88.24 | 74.07 | -14.17* |
| | | | | 2 | 83.33 | 73.17 | -10.16* |
| | | | | 3 | 85.75 | 71.43 | -14.32* |
| | | | | 4 | 90.91 | 73.17 | -17.74* |
| | 5 | 80.49 | 8.05 | 1 | 88.24 | 68.18 | -20.06* |
| | | | | 2 | 82.19 | 71.43 | -10.76* |
| | | | | 3 | 76.92 | 65.22 | -11.70* |
| | | | | 4 | 90.91 | 72.29 | -18.62* |
| | 6 | 72.67 | 7.27 | 1 | 71.43 | 65.93 | - 5.50 |
| | | | | 2 | 81.08 | 67.42 | -13.66* |
| | | | | 3 | 73.17 | 68.97 | - 4.20 |
| | | | | 4 | 78.95 | 71.43 | - 7.52* |
| | 7 | 68.77 | 6.88 | 1 | 75.00 | 63.16 | -11.84* |
| | | | | 2 | 75.00 | 64.52 | -10.48* |
| | | | | 3 | 75.00 | 63.16 | -11.84* |
| | | | | 4 | 78.95 | 65.22 | -13.73* |
| | 8 | 74.10 | 7.41 | 1 | 76.92 | 65.93 | -10.99* |
| | | | | 2 | 68.18 | 61.22 | - 6.96 |
| | | | | 3 | 75.00 | 62.50 | -12.50* |
| | | | | 4 | 72.29 | 61.22 | -11.07* |
| | 9 | 75.84 | 7.58 | 1 | 78.95 | 62.50 | -16.45* |
| | | | | 2 | 71.43 | 62.50 | - 8.93* |
| | | | | 3 | 71.43 | 62.50 | - 8.93* |
| | | | | 4 | 75.00 | 60.00 | -15.00* |
| | 10 | 74.39 | 7.44 | 1 | 80.00 | 68.97 | -12.03* |
| | | | | 2 | 78.95 | 65.93 | -13.02* |
| | | | | 3 | 80.00 | 67.42 | -12.58* |
| | | | | 4 | 81.08 | 67.42 | -13.66* |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| DM | 1 | 92.80 | 9.28 | 1 | 96.77 | 93.75 | - 3.02 |
| | | | | 2 | 96.77 | 96.77 | 0 |
| | | | | 3 | 100.00 | 93.75 | - 6.25 |
| | | | | 4 | 90.91 | 93.75 | + 2.84 |
| | 2 | 78.98 | 7.90 | 1 | 81.08 | 80.00 | - 1.08 |
| | | | | 2 | 80.00 | 72.29 | - 7.71 |
| | | | | 3 | 85.71 | 76.92 | - 8.79* |
| | | | | 4 | 84.51 | 76.92 | - 7.59 |
| | 3 | 83.74 | 8.37 | 1 | 85.71 | 70.59 | -15.12* |
| | | | | 2 | 85.71 | 82.19 | - 3.52 |
| | | | | 3 | 78.95 | 85.71 | + 6.76 |
| | | | | 4 | 92.31 | 83.33 | - 8.98* |
| | 4 | 97.44 | 9.74 | 1 | 96.77 | 93.75 | - 3.02 |
| | | | | 2 | 78.95 | 85.71 | + 6.76 |
| | | | | 3 | 81.08 | 89.55 | + 8.47 |
| | | | | 4 | 95.24 | 89.55 | - 5.69 |
| | 5 | 93.41 | 9.34 | 1 | 100.00 | 100.00 | 0 |
| | | | | 2 | 105.26 | 90.91 | -14.35* |
| | | | | 3 | 113.21 | 96.77 | -16.44* |
| | | | | 4 | 105.26 | 93.75 | -11.51* |
| | 6 | 90.24 | 9.02 | 1 | 88.24 | 81.08 | - 7.16 |
| | | | | 2 | 95.24 | 89.55 | - 5.69 |
| | | | | 3 | 92.31 | 90.91 | - 1.40 |
| | | | | 4 | 92.31 | 88.24 | - 4.07 |
| | 7 | 94.36 | 9.44 | 1 | 95.24 | 93.75 | - 1.49 |
| | | | | 2 | 101.69 | 89.55 | -12.14* |
| | | | | 3 | 100.00 | 95.24 | - 4.76 |
| | | | | 4 | 93.75 | 81.08 | -12.67* |
| | 8 | 96.29 | 9.63 | 1 | 105.26 | 100.00 | - 5.26 |
| | | | | 2 | 107.14 | 93.75 | -13.39* |
| | | | | 3 | 107.14 | 96.77 | -10.37* |
| | | | | 4 | 107.14 | 92.31 | -14.83* |
| | 9 | 83.64 | 8.36 | 1 | 103.45 | 90.91 | -12.54* |
| | | | | 2 | 100.00 | 100.00 | 0 |
| | | | | 3 | 109.09 | 89.55 | -19.54* |
| | | | | 4 | 100.00 | 88.24 | -11.76* |
| | 10 | 82.98 | 8.30 | 1 | 85.71 | 81.08 | - 4.63 |
| | | | | 2 | 96.77 | 75.95 | -20.82* |
| | | | | 3 | 83.33 | 81.08 | - 2.25 |
| | | | | 4 | 86.96 | 76.92 | -10.04* |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| KN | 1 | 84.97 | 8.50 | 1 | 85.71 | 78.95 | - 6.76 |
| | | | | 2 | 83.33 | 85.71 | + 2.38 |
| | | | | 3 | 85.71 | 78.95 | - 6.76 |
| | | | | 4 | 88.24 | 76.92 | -11.32* |
| | 2 | 76.32 | 7.63 | 1 | 68.97 | 68.18 | - 0.79 |
| | | | | 2 | 73.17 | 68.97 | - 4.20 |
| | | | | 3 | 69.77 | 68.18 | - 1.59 |
| | | | | 4 | 74.07 | 68.18 | - 5.89 |
| | 3 | 71.06 | 7.11 | 1 | 76.92 | 73.17 | - 3.75 |
| | | | | 2 | 75.00 | 69.77 | - 5.23 |
| | | | | 3 | 69.77 | 66.67 | - 3.10 |
| | | | | 4 | 75.00 | 66.67 | - 8.33* |
| | 4 | 74.13 | 7.41 | 1 | 80.00 | 75.00 | - 5.00 |
| | | | | 2 | 75.95 | 72.29 | - 3.66 |
| | | | | 3 | 72.29 | 71.43 | - 0.76 |
| | | | | 4 | 73.17 | 71.43 | - 1.74 |
| | 5 | 82.70 | 8.27 | 1 | 80.00 | 78.95 | - 1.05 |
| | | | | 2 | 80.00 | 75.00 | - 5.00 |
| | | | | 3 | 76.92 | 77.92 | + 1.00 |
| | | | | 4 | 85.71 | 80.00 | - 5.71 |
| | 6 | 87.39 | 8.74 | 1 | 89.55 | 85.71 | - 3.84 |
| | | | | 2 | 92.31 | 82.19 | -10.12* |
| | | | | 3 | 89.55 | 83.33 | - 6.22 |
| | | | | 4 | 86.96 | 77.92 | - 9.04* |
| | 7 | 76.70 | 7.67 | 1 | 85.71 | 71.43 | -14.28* |
| | | | | 2 | 78.95 | 78.95 | 0 |
| | | | | 3 | 78.95 | 77.92 | - 1.03 |
| | | | | 4 | 75.00 | 75.00 | 0 |
| | 8 | 87.83 | 8.78 | 1 | 89.55 | 80.00 | - 9.55* |
| | | | | 2 | 90.91 | 81.08 | - 9.83* |
| | | | | 3 | 83.33 | 76.92 | - 6.41 |
| | | | | 4 | 84.51 | 75.00 | - 9.49* |
| | 9 | 75.97 | 7.60 | 1 | 78.95 | 71.43 | - 7.52 |
| | | | | 2 | 75.95 | 68.18 | - 7.77* |
| | | | | 3 | 71.43 | 69.77 | - 1.66 |
| | | | | 4 | 71.43 | 71.43 | 0 |
| | 10 | 77.78 | 7.78 | 1 | 81.08 | 69.77 | -11.31* |
| | | | | 2 | 73.17 | 73.17 | 0 |
| | | | | 3 | 72.29 | 73.17 | + 0.88 |
| | | | | 4 | 75.00 | 78.95 | + 3.95 |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| PP | 1 | 78.31 | 7.83 | 1 | 76.92 | 71.43 | - 5.49 |
| | | | | 2 | 81.08 | 71.43 | - 8.65* |
| | | | | 3 | 73.17 | 69.77 | - 3.40 |
| | | | | 4 | 71.43 | 71.43 | 0 |
| | 2 | 73.52 | 7.35 | 1 | 68.18 | 68.97 | + 0.79 |
| | | | | 2 | 75.00 | 62.50 | -12.50* |
| | | | | 3 | 75.00 | 61.86 | -13.14* |
| | | | | 4 | 81.08 | 63.16 | -17.92* |
| | 3 | 89.64 | 8.96 | 1 | 89.55 | 80.00 | - 9.55* |
| | | | | 2 | 100.00 | 82.19 | -17.81* |
| | | | | 3 | 92.31 | 76.92 | -15.39* |
| | | | | 4 | 93.75 | 82.19 | - 9.56* |
| | 4 | 83.33 | 8.33 | 1 | 81.08 | 72.29 | - 8.79* |
| | | | | 2 | 83.33 | 78.95 | - 4.38 |
| | | | | 3 | 98.36 | 72.29 | -26.07* |
| | | | | 4 | 83.33 | 75.95 | - 7.38 |
| | 5 | 62.88 | 6.29 | 1 | 58.25 | 61.22 | + 2.97 |
| | | | | 2 | 63.83 | 63.83 | 0 |
| | | | | 3 | 60.00 | 61.22 | + 1.22 |
| | | | | 4 | 71.43 | 58.25 | -13.18* |
| | 6 | 73.81 | 7.38 | 1 | 77.92 | 70.59 | - 7.31 |
| | | | | 2 | 77.92 | 71.43 | - 6.49 |
| | | | | 3 | 77.92 | 69.77 | - 8.15* |
| | | | | 4 | 77.92 | 68.97 | - 8.95* |
| | 7 | 67.17 | 6.72 | 1 | 70.59 | 68.97 | - 1.62 |
| | | | | 2 | 80.00 | 74.07 | - 5.93 |
| | | | | 3 | 78.95 | 67.42 | -11.53* |
| | | | | 4 | 78.95 | 65.93 | -13.02* |
| | 8 | 81.24 | 8.12 | 1 | 83.33 | 68.97 | -14.36* |
| | | | | 2 | 83.33 | 68.97 | -14.36* |
| | | | | 3 | 75.00 | 69.77 | - 5.23 |
| | | | | 4 | 84.51 | 68.18 | -16.33* |
| | 9 | 83.04 | 8.30 | 1 | 85.71 | 72.29 | -13.42* |
| | | | | 2 | 83.33 | 75.00 | - 8.33* |
| | | | | 3 | 83.33 | 68.97 | -14.36* |
| | | | | 4 | 78.95 | 73.17 | - 5.78 |
| | 10 | 75.31 | 7.53 | 1 | 76.92 | 70.59 | - 6.33 |
| | | | | 2 | 81.08 | 73.17 | - 7.91* |
| | | | | 3 | 76.92 | 70.59 | - 6.33 |
| | | | | 4 | 85.71 | 78.95 | - 6.76 |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| KP | 1 | 88.14 | 8.81 | 1 | 78.95 | 75.00 | - 3.95 |
| | | | | 2 | 83.33 | 75.00 | -12.33* |
| | | | | 3 | 90.91 | 70.59 | -20.32* |
| | | | | 4 | 88.24 | 69.77 | -18.47* |
| | 2 | 69.39 | 6.94 | 1 | 73.17 | 70.59 | - 2.58 |
| | | | | 2 | 74.07 | 67.42 | - 6.65 |
| | | | | 3 | 69.77 | 62.50 | - 7.27* |
| | | | | 4 | 73.17 | 68.18 | - 4.99 |
| | 3 | 76.35 | 7.64 | 1 | 73.17 | 71.43 | - 1.74 |
| | | | | 2 | 82.19 | 65.22 | -16.97* |
| | | | | 3 | 68.97 | 64.52 | - 4.45 |
| | | | | 4 | 73.17 | 64.52 | - 8.65* |
| | 4 | 101.71 | 10.17 | 1 | 103.45 | 93.75 | - 9.70 |
| | | | | 2 | 103.45 | 89.55 | -13.90* |
| | | | | 3 | 95.24 | 90.91 | - 4.33 |
| | | | | 4 | 96.77 | 89.55 | - 7.22 |
| | 5 | 81.00 | 8.10 | 1 | 98.36 | 75.00 | -23.36* |
| | | | | 2 | 83.33 | 75.00 | - 8.33* |
| | | | | 3 | 86.96 | 75.00 | -16.96* |
| | | | | 4 | 71.43 | 71.43 | 0 |
| | 6 | 79.99 | 8.00 | 1 | 96.77 | 69.77 | -27.00* |
| | | | | 2 | 88.24 | 75.00 | -13.24* |
| | | | | 3 | 89.55 | 77.92 | -11.63* |
| | | | | 4 | 75.95 | 67.42 | - 8.53* |
| | 7 | 85.14 | 8.51 | 1 | 88.24 | 75.95 | -12.29* |
| | | | | 2 | 82.19 | 73.17 | - 9.02* |
| | | | | 3 | 78.95 | 68.18 | -10.77* |
| | | | | 4 | 81.08 | 71.43 | - 9.65* |
| | 8 | 63.46 | 6.35 | 1 | 65.22 | 63.83 | - 1.39 |
| | | | | 2 | 71.43 | 59.41 | -12.02* |
| | | | | 3 | 81.08 | 63.16 | -17.92* |
| | | | | 4 | 84.51 | 62.50 | -22.01* |
| | 9 | 68.86 | 6.89 | 1 | 69.77 | 71.43 | + 1.76 |
| | | | | 2 | 65.22 | 62.50 | - 2.72 |
| | | | | 3 | 73.17 | 65.22 | - 7.95* |
| | | | | 4 | 70.59 | 60.00 | -10.59* |
| | 10 | 82.66 | 8.27 | 1 | 84.51 | 76.92 | - 7.59 |
| | | | | 2 | 90.91 | 75.95 | -14.96* |
| | | | | 3 | 82.19 | 76.92 | - 5.27 |
| | | | | 4 | 81.08 | 75.00 | - 6.08 |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| MS | 1 | 66.19 | 6.62 | 1 | 68.18 | 63.83 | - 4.35 |
| | | | | 2 | 62.50 | 63.83 | + 1.33 |
| | | | | 3 | 65.22 | 65.22 | 0 |
| | | | | 4 | 76.92 | 68.18 | - 8.74* |
| | 2 | 69.34 | 6.93 | 1 | 66.67 | 66.67 | 0 |
| | | | | 2 | 68.18 | 66.67 | - 1.51 |
| | | | | 3 | 76.92 | 63.16 | -13.76* |
| | | | | 4 | 61.86 | 63.83 | + 1.97 |
| | 3 | 73.04 | 7.30 | 1 | 73.17 | 59.41 | -13.76* |
| | | | | 2 | 73.17 | 58.82 | -14.35* |
| | | | | 3 | 59.41 | 56.60 | - 2.81 |
| | | | | 4 | 57.97 | 58.82 | + 0.85 |
| | 4 | 77.27 | 7.73 | 1 | 77.92 | 68.18 | - 9.74* |
| | | | | 2 | 80.00 | 63.83 | -16.17* |
| | | | | 3 | 83.33 | 65.22 | -18.11* |
| | | | | 4 | 75.00 | 64.52 | -10.48* |
| | 5 | 85.50 | 8.55 | 1 | 82.19 | 73.17 | - 9.02* |
| | | | | 2 | 77.92 | 70.59 | - 7.33 |
| | | | | 3 | 76.92 | 69.77 | - 7.15 |
| | | | | 4 | 78.95 | 65.22 | -13.73* |
| | 6 | 72.03 | 7.20 | 1 | 69.77 | 62.50 | - 7.27* |
| | | | | 2 | 76.92 | 63.83 | -13.09* |
| | | | | 3 | 93.75 | 62.50 | -31.25* |
| | | | | 4 | 80.00 | 63.83 | -16.17* |
| | 7 | 81.10 | 8.11 | 1 | 88.24 | 72.29 | -15.95* |
| | | | | 2 | 88.24 | 69.77 | -18.47* |
| | | | | 3 | 75.00 | 65.93 | - 9.07* |
| | | | | 4 | 76.92 | 68.18 | - 8.74* |
| | 8 | 65.03 | 6.50 | 1 | 80.00 | 61.22 | -18.78* |
| | | | | 2 | 76.92 | 59.41 | -17.51* |
| | | | | 3 | 72.29 | 60.61 | -11.68* |
| | | | | 4 | 74.07 | 67.42 | - 6.55* |
| | 9 | 79.33 | 7.93 | 1 | 80.00 | 62.50 | -17.50* |
| | | | | 2 | 93.75 | 63.16 | -30.59* |
| | | | | 3 | 78.95 | 68.18 | -10.77* |
| | | | | 4 | 78.95 | 65.22 | -13.73* |
| | 10 | 86.32 | 8.63 | 1 | 86.96 | 61.22 | -25.74* |
| | | | | 2 | 73.17 | 68.18 | - 6.99 |
| | | | | 3 | 71.43 | 63.83 | - 7.60 |
| | | | | 4 | 71.43 | 64.52 | - 6.91 |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| KS | 1 | 79.28 | 7.93 | 1 | 85.71 | 78.95 | - 6.76 |
| | | | | 2 | 76.92 | 69.77 | - 7.15 |
| | | | | 3 | 83.33 | 71.43 | -11.90* |
| | | | | 4 | 83.33 | 66.67 | -16.66* |
| | 2 | 74.18 | 7.42 | 1 | 74.07 | 68.18 | - 5.89 |
| | | | | 2 | 76.92 | 68.18 | - 6.74 |
| | | | | 3 | 71.43 | 68.97 | - 2.46 |
| | | | | 4 | 78.95 | 69.77 | - 9.18* |
| | 3 | 67.72 | 6.77 | 1 | 65.22 | 62.50 | - 2.72 |
| | | | | 2 | 75.00 | 63.83 | -11.17* |
| | | | | 3 | 62.50 | 61.22 | - 1.28 |
| | | | | 4 | 75.00 | 63.83 | -11.17* |
| | 4 | 75.71 | 7.57 | 1 | 72.29 | 63.83 | - 8.46* |
| | | | | 2 | 65.22 | 65.93 | + 0.71 |
| | | | | 3 | 71.43 | 58.82 | -12.61* |
| | | | | 4 | 82.19 | 66.67 | -15.52* |
| | 5 | 82.62 | 8.26 | 1 | 84.51 | 75.00 | - 9.51* |
| | | | | 2 | 71.43 | 74.07 | + 2.64 |
| | | | | 3 | 83.33 | 71.43 | -11.90* |
| | | | | 4 | 76.92 | 68.18 | - 8.74* |
| | 6 | 73.16 | 7.32 | 1 | 67.42 | 61.22 | - 6.20 |
| | | | | 2 | 62.50 | 57.14 | - 5.36 |
| | | | | 3 | 61.22 | 62.50 | + 1.28 |
| | | | | 4 | 69.77 | 61.22 | - 8.55* |
| | 7 | 75.10 | 7.51 | 1 | 81.08 | 66.67 | -14.41* |
| | | | | 2 | 72.29 | 65.22 | - 7.07 |
| | | | | 3 | 88.24 | 65.93 | -22.31* |
| | | | | 4 | 80.00 | 60.00 | -20.00* |
| | 8 | 80.70 | 8.07 | 1 | 86.96 | 75.95 | -11.01* |
| | | | | 2 | 95.24 | 76.92 | -18.32* |
| | | | | 3 | 88.24 | 78.95 | - 9.29* |
| | | | | 4 | 77.92 | 78.95 | + 1.03 |
| | 9 | 77.73 | 7.77 | 1 | 83.33 | 73.17 | -10.16* |
| | | | | 2 | 78.95 | 69.77 | - 9.18* |
| | | | | 3 | 76.92 | 71.45 | - 5.47 |
| | | | | 4 | 77.92 | 65.93 | -11.99* |
| | 10 | 83.04 | 8.30 | 1 | 88.24 | 69.77 | -18.47* |
| | | | | 2 | 93.75 | 70.59 | -23.16* |
| | | | | 3 | 83.33 | 70.59 | -12.74* |
| | | | | 4 | 80.00 | 71.43 | - 8.57* |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| SW | 1 | 94.77 | 9.48 | 1 | 100.00 | 90.91 | - 9.09 |
| | | | | 2 | 107.14 | 90.91 | -16.23* |
| | | | | 3 | 90.91 | 90.91 | 0 |
| | | | | 4 | 93.75 | 90.91 | - 2.84 |
| | 2 | 100.82 | 10.08 | 1 | 89.55 | 93.25 | + 3.70 |
| | | | | 2 | 107.14 | 96.77 | -10.37* |
| | | | | 3 | 107.14 | 92.31 | -14.83* |
| | | | | 4 | 107.14 | 93.75 | -13.39* |
| | 3 | 96.99 | 9.70 | 1 | 101.69 | 81.08 | -20.61* |
| | | | | 2 | 88.24 | 88.24 | 0 |
| | | | | 3 | 89.55 | 93.75 | - 4.20 |
| | | | | 4 | 105.26 | 85.71 | -19.55* |
| | 4 | 97.92 | 9.79 | 1 | 98.36 | 75.00 | -23.36* |
| | | | | 2 | 96.77 | 72.29 | -24.48* |
| | | | | 3 | 98.36 | 73.17 | -25.19* |
| | | | | 4 | 103.45 | 77.92 | -25.53* |
| | 5 | 105.41 | 10.54 | 1 | 107.14 | 85.71 | -21.43* |
| | | | | 2 | 109.09 | 88.24 | -20.85* |
| | | | | 3 | 111.11 | 84.51 | -26.60* |
| | | | | 4 | 111.11 | 74.07 | -37.04* |
| | 6 | 107.84 | 10.78 | 1 | 107.14 | 78.95 | -28.19* |
| | | | | 2 | 96.77 | 82.19 | -14.58* |
| | | | | 3 | 92.31 | 75.00 | -17.31* |
| | | | | 4 | 101.69 | 72.29 | -29.40* |
| | 7 | 104.18 | 10.42 | 1 | 109.09 | 81.08 | -27.01* |
| | | | | 2 | 109.09 | 78.95 | -30.14* |
| | | | | 3 | 111.11 | 83.33 | -27.78* |
| | | | | 4 | 101.69 | 81.08 | -20.61* |
| | 8 | 95.25 | 9.53 | 1 | 95.24 | 69.77 | -25.47* |
| | | | | 2 | 96.77 | 75.00 | -21.77* |
| | | | | 3 | 88.24 | 72.29 | -15.95* |
| | | | | 4 | 93.75 | 70.59 | -23.16* |
| | 9 | 104.18 | 10.42 | 1 | 107.14 | 84.51 | -22.63* |
| | | | | 2 | 103.45 | 82.19 | -21.26* |
| | | | | 3 | 103.45 | 86.96 | -16.49* |
| | | | | 4 | 96.77 | 78.95 | -17.82* |
| | 10 | 103.51 | 10.35 | 1 | 103.45 | 72.29 | -31.16* |
| | | | | 2 | 105.26 | 84.51 | -20.75* |
| | | | | 3 | 101.69 | 71.43 | -30.26* |
| | | | | 4 | 117.65 | 80.00 | -37.65* |

RAW DATA FOR INSTRUMENTAL CONDITIONING PERIOD
EXPERIMENTAL GROUP II--DELAYED FEEDBACK

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| BJA | 1 | 87.49 | 8.75 | 1 | 93.75 | 81.08 | -12.67* |
| | | | | 2 | 88.24 | 85.71 | - 2.53 |
| | | | | 3 | 85.71 | 81.08 | - 4.63 |
| | | | | 4 | 90.91 | 83.33 | - 7.58 |
| | 2 | 93.10 | 9.31 | 1 | 98.36 | 88.24 | -10.12* |
| | | | | 2 | 100.00 | 92.31 | - 7.69 |
| | | | | 3 | 100.00 | 88.24 | -11.76* |
| | | | | 4 | 93.75 | 85.71 | - 8.04 |
| | 3 | 95.83 | 9.58 | 1 | 96.77 | 83.33 | -13.44* |
| | | | | 2 | 100.00 | 82.19 | -18.81* |
| | | | | 3 | 98.36 | 88.24 | -10.12* |
| | | | | 4 | 90.91 | 83.33 | - 7.58 |
| | 4 | 88.64 | 8.86 | 1 | 93.75 | 84.51 | - 9.24* |
| | | | | 2 | 90.91 | 83.33 | - 7.58 |
| | | | | 3 | 96.77 | 89.55 | - 7.22 |
| | | | | 4 | 95.24 | 88.24 | - 7.00 |
| | 5 | 90.49 | 9.05 | 1 | 93.75 | 78.95 | -14.80* |
| | | | | 2 | 92.31 | 78.95 | -13.36* |
| | | | | 3 | 90.91 | 78.95 | -11.96* |
| | | | | 4 | 88.24 | 76.92 | -11.32* |
| | 6 | 93.95 | 9.40 | 1 | 92.31 | 82.19 | -10.12* |
| | | | | 2 | 88.24 | 75.95 | -12.29* |
| | | | | 3 | 93.75 | 81.08 | -12.67* |
| | | | | 4 | 88.24 | 73.17 | -15.07* |
| | 7 | 86.05 | 8.61 | 1 | 83.33 | 73.17 | -10.16* |
| | | | | 2 | 86.96 | 76.92 | -10.04* |
| | | | | 3 | 82.19 | 80.00 | - 2.19 |
| | | | | 4 | 85.71 | 80.00 | - 5.71 |
| | 8 | 98.48 | 9.85 | 1 | 98.36 | 89.55 | - 8.81 |
| | | | | 2 | 90.91 | 83.33 | - 7.58 |
| | | | | 3 | 95.24 | 88.24 | - 7.00 |
| | | | | 4 | 93.75 | 85.71 | - 8.04 |
| | 9 | 85.36 | 8.54 | 1 | 93.75 | 84.51 | - 9.24* |
| | | | | 2 | 89.55 | 84.51 | - 5.04 |
| | | | | 3 | 93.75 | 85.71 | - 8.04 |
| | | | | 4 | 103.45 | 83.33 | -21.12* |
| | 10 | 95.25 | 9.53 | 1 | 96.77 | 86.96 | - 9.81* |
| | | | | 2 | 95.24 | 85.71 | - 9.53* |
| | | | | 3 | 95.24 | 88.24 | - 7.00 |
| | | | | 4 | 95.24 | 88.24 | - 7.00 |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| MAB | 1 | 83.37 | 8.34 | 1 | 85.71 | 73.17 | -12.54* |
| | | | | 2 | 85.71 | 71.43 | -14.28* |
| | | | | 3 | 76.92 | 76.92 | 0 |
| | | | | 4 | 76.92 | 71.43 | - 5.49 |
| | 2 | 76.67 | 7.67 | 1 | 83.33 | 68.97 | -14.36* |
| | | | | 2 | 71.43 | 67.42 | - 4.01 |
| | | | | 3 | 74.07 | 71.43 | - 2.64 |
| | | | | 4 | 85.71 | 69.77 | -15.94* |
| | 3 | 86.35 | 8.64 | 1 | 90.91 | 75.00 | -15.91* |
| | | | | 2 | 85.71 | 75.00 | -10.71* |
| | | | | 3 | 82.19 | 73.17 | - 9.02* |
| | | | | 4 | 96.77 | 65.22 | -31.55* |
| | 4 | 75.72 | 7.57 | 1 | 76.92 | 69.77 | - 7.15 |
| | | | | 2 | 80.00 | 69.77 | -11.23* |
| | | | | 3 | 82.19 | 68.97 | -13.22* |
| | | | | 4 | 81.08 | 71.43 | - 9.65* |
| | 5 | 80.57 | 8.06 | 1 | 82.19 | 67.42 | -14.77* |
| | | | | 2 | 83.33 | 68.18 | -15.15* |
| | | | | 3 | 90.91 | 69.77 | -21.14* |
| | | | | 4 | 84.51 | 70.59 | -13.92* |
| | 6 | 91.01 | 9.10 | 1 | 95.24 | 78.95 | -16.29* |
| | | | | 2 | 90.91 | 76.92 | -13.99* |
| | | | | 3 | 88.24 | 73.17 | -15.07* |
| | | | | 4 | 96.77 | 68.18 | -28.59* |
| | 7 | 92.86 | 9.29 | 1 | 95.24 | 77.92 | -17.32* |
| | | | | 2 | 93.75 | 85.71 | - 8.04* |
| | | | | 3 | 83.33 | 78.95 | - 4.38 |
| | | | | 4 | 101.69 | 84.51 | -17.18* |
| | 8 | 86.15 | 8.62 | 1 | 89.55 | 80.00 | - 9.55* |
| | | | | 2 | 83.33 | 75.95 | - 7.38 |
| | | | | 3 | 90.91 | 75.95 | -14.96* |
| | | | | 4 | 100.00 | 80.00 | -20.00* |
| | 9 | 92.68 | 9.27 | 1 | 100.00 | 81.08 | -18.92* |
| | | | | 2 | 100.00 | 83.33 | -16.67* |
| | | | | 3 | 95.24 | 83.33 | -11.91* |
| | | | | 4 | 90.91 | 83.33 | - 7.58 |
| | 10 | 88.83 | 8.88 | 1 | 100.00 | 75.00 | -25.00* |
| | | | | 2 | 77.92 | 75.00 | - 2.92 |
| | | | | 3 | 84.51 | 77.92 | - 6.59 |
| | | | | 4 | 83.33 | 76.92 | - 6.41 |

| Subject | Day | Resting Heart Rate | Decre-ment | Trial | Before Stimulus | After Stimulus | Differ-ence |
|---|---|---|---|---|---|---|---|
| CB | 1 | 95.07 | 9.51 | 1 | 81.08 | 81.08 | 0 |
| | | | | 2 | 85.71 | 73.17 | -12.54* |
| | | | | 3 | 93.75 | 76.92 | -16.83* |
| | | | | 4 | 88.24 | 78.95 | - 9.29 |
| | 2 | 79.85 | 7.99 | 1 | 76.92 | 68.18 | - 8.74* |
| | | | | 2 | 75.00 | 69.77 | - 5.23 |
| | | | | 3 | 78.95 | 63.83 | -15.12* |
| | | | | 4 | 82.19 | 60.61 | -21.58* |
| | 3 | 72.86 | 7.29 | 1 | 73.17 | 66.67 | - 6.50 |
| | | | | 2 | 69.77 | 64.52 | - 5.25 |
| | | | | 3 | 63.83 | 61.22 | - 2.61 |
| | | | | 4 | 66.67 | 63.16 | - 3.51 |
| | 4 | 73.89 | 7.39 | 1 | 72.29 | 65.22 | - 7.07 |
| | | | | 2 | 71.43 | 60.00 | -11.43* |
| | | | | 3 | 65.93 | 60.00 | - 5.93 |
| | | | | 4 | 70.59 | 62.50 | - 8.09* |
| | 5 | 83.37 | 8.34 | 1 | 88.24 | 73.17 | -15.07* |
| | | | | 2 | 83.33 | 73.17 | -10.16* |
| | | | | 3 | 81.08 | 75.00 | - 6.08 |
| | | | | 4 | 85.71 | 72.29 | -13.42* |
| | 6 | 91.01 | 9.10 | 1 | 92.31 | 68.97 | -23.34* |
| | | | | 2 | 84.51 | 73.17 | -11.34* |
| | | | | 3 | 83.33 | 68.97 | -14.36* |
| | | | | 4 | 81.08 | 70.59 | -10.49* |
| | 7 | 64.18 | 6.42 | 1 | 61.22 | 49.59 | -11.63* |
| | | | | 2 | 61.86 | 51.72 | -10.14* |
| | | | | 3 | 63.83 | 51.28 | -12.55* |
| | | | | 4 | 57.69 | 53.57 | - 4.12 |
| | 8 | 90.03 | 9.00 | 1 | 93.21 | 78.95 | -14.26* |
| | | | | 2 | 93.75 | 76.92 | -16.83* |
| | | | | 3 | 86.96 | 81.08 | - 5.88 |
| | | | | 4 | 92.31 | 75.00 | -17.31* |
| | 9 | 90.28 | 9.03 | 1 | 93.75 | 86.96 | - 6.79 |
| | | | | 2 | 95.24 | 86.96 | - 8.28 |
| | | | | 3 | 98.36 | 84.51 | -13.85* |
| | | | | 4 | 98.36 | 83.33 | -15.03* |
| | 10 | 74.60 | 7.46 | 1 | 90.91 | 62.50 | -22.41* |
| | | | | 2 | 72.29 | 66.67 | - 5.62 |
| | | | | 3 | 75.00 | 60.00 | -15.00* |
| | | | | 4 | 76.92 | 57.69 | -19.23* |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| CE | 1 | 75.67 | 7.57 | 1 | 88.24 | 76.92 | -11.32* |
| | | | | 2 | 78.95 | 68.18 | -10.77* |
| | | | | 3 | 82.19 | 71.43 | -10.76* |
| | | | | 4 | 66.67 | 70.59 | + 3.92 |
| | 2 | 73.81 | 7.38 | 1 | 73.17 | 69.77 | - 3.40 |
| | | | | 2 | 68.18 | 63.83 | - 4.35 |
| | | | | 3 | 70.59 | 65.93 | - 4.66 |
| | | | | 4 | 73.17 | 69.77 | - 8.06* |
| | 3 | 76.28 | 7.63 | 1 | 75.00 | 71.43 | - 3.57 |
| | | | | 2 | 69.77 | 70.59 | + 0.82 |
| | | | | 3 | 88.24 | 71.43 | -16.81* |
| | | | | 4 | 72.29 | 69.77 | - 2.52 |
| | 4 | 88.58 | 8.86 | 1 | 83.33 | 75.00 | - 8.33 |
| | | | | 2 | 81.08 | 76.92 | - 4.16 |
| | | | | 3 | 83.33 | 69.77 | -13.56* |
| | | | | 4 | 81.08 | 68.18 | -12.90* |
| | 5 | 77.87 | 7.79 | 1 | 83.33 | 73.17 | -10.16* |
| | | | | 2 | 98.36 | 70.59 | -27.77* |
| | | | | 3 | 83.33 | 71.43 | -11.90* |
| | | | | 4 | 73.17 | 62.50 | -10.67* |
| | 6 | 85.74 | 8.57 | 1 | 84.51 | 70.59 | -13.92* |
| | | | | 2 | 84.51 | 73.17 | -11.34* |
| | | | | 3 | 82.19 | 73.17 | - 9.02* |
| | | | | 4 | 78.95 | 68.97 | - 9.98* |
| | 7 | 74.08 | 7.41 | 1 | 75.95 | 68.18 | - 7.77* |
| | | | | 2 | 83.33 | 66.67 | -16.66* |
| | | | | 3 | 75.95 | 65.22 | -10.73* |
| | | | | 4 | 86.96 | 68.97 | -15.99* |
| | 8 | 65.83 | 6.58 | 1 | 69.77 | 61.22 | - 8.55* |
| | | | | 2 | 85.71 | 60.00 | -25.71* |
| | | | | 3 | 72.29 | 58.25 | -14.04* |
| | | | | 4 | 69.77 | 61.22 | - 8.55* |
| | 9 | 79.85 | 7.99 | 1 | 73.17 | 63.83 | - 9.34* |
| | | | | 2 | 75.00 | 69.77 | - 5.23 |
| | | | | 3 | 83.33 | 66.67 | -16.66* |
| | | | | 4 | 85.71 | 66.67 | -19.04* |
| | 10 | 111.91 | 11.19 | 1 | 117.65 | 84.51 | -33.14* |
| | | | | 2 | 109.09 | 75.95 | -33.14* |
| | | | | 3 | 100.00 | 85.71 | -14.29* |
| | | | | 4 | 100.00 | 85.71 | -14.29* |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| CH | 1 | 93.27 | 9.33 | 1 | 103.45 | 90.91 | -12.54* |
| | | | | 2 | 108.11 | 100.00 | - 8.12 |
| | | | | 3 | 107.14 | 93.75 | -13.39* |
| | | | | 4 | 100.00 | 100.00 | 0 |
| | 2 | 108.03 | 10.80 | 1 | 103.45 | 90.91 | -12.54* |
| | | | | 2 | 108.11 | 100.00 | - 8.11 |
| | | | | 3 | 107.14 | 93.75 | -13.39* |
| | | | | 4 | 100.00 | 100.00 | 0 |
| | 3 | 87.49 | 8.75 | 1 | 83.33 | 76.92 | - 6.41 |
| | | | | 2 | 78.95 | 78.95 | 0 |
| | | | | 3 | 78.95 | 78.95 | 0 |
| | | | | 4 | 76.92 | 78.95 | + 2.03 |
| | 4 | 86.72 | 8.67 | 1 | 93.75 | 74.07 | -19.68* |
| | | | | 2 | 80.00 | 76.92 | - 3.08 |
| | | | | 3 | 81.08 | 73.17 | - 7.91 |
| | | | | 4 | 81.08 | 71.43 | - 9.65* |
| | 5 | 87.07 | 8.71 | 1 | 82.19 | 77.92 | - 4.27 |
| | | | | 2 | 85.71 | 75.00 | -10.71* |
| | | | | 3 | 85.71 | 81.08 | - 4.63 |
| | | | | 4 | 83.33 | 77.92 | - 5.41 |
| | 6 | 91.43 | 9.14 | 1 | 90.91 | 72.29 | -18.62* |
| | | | | 2 | 81.08 | 75.95 | - 5.13 |
| | | | | 3 | 83.33 | 70.59 | -12.74* |
| | | | | 4 | 83.33 | 74.07 | - 9.26* |
| | 7 | 88.22 | 8.82 | 1 | 100.00 | 75.00 | -25.00* |
| | | | | 2 | 96.77 | 78.95 | -17.82* |
| | | | | 3 | 86.96 | 77.92 | - 9.04* |
| | | | | 4 | 84.51 | 82.19 | - 2.32 |
| | 8 | 76.42 | 7.64 | 1 | 98.36 | 71.43 | -26.93* |
| | | | | 2 | 78.95 | 70.59 | - 8.36* |
| | | | | 3 | 84.51 | 71.43 | -13.08* |
| | | | | 4 | 74.07 | 69.77 | - 4.30 |
| | 9 | 74.82 | 7.48 | 1 | 85.71 | 75.00 | -10.71* |
| | | | | 2 | 85.71 | 83.33 | - 2.38* |
| | | | | 3 | 83.33 | 78.95 | - 4.38 |
| | | | | 4 | 76.92 | 66.67 | -10.25* |
| | 10 | 90.08 | 9.01 | 1 | 92.31 | 75.00 | -17.31* |
| | | | | 2 | 89.55 | 80.00 | - 9.55* |
| | | | | 3 | 90.91 | 76.92 | -13.99* |
| | | | | 4 | 84.51 | 82.19 | - 2.32 |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| DL | 1 | 90.97 | 9.10 | 1 | 90,91 | 85.71 | - 5.20 |
| | | | | 2 | 90.91 | 88.24 | - 2.67 |
| | | | | 3 | 90.91 | 93.75 | + 2.84 |
| | | | | 4 | 96.77 | 76.92 | -19.85* |
| | 2 | 84.52 | 8.45 | 1 | 95.24 | 82.19 | -13.05* |
| | | | | 2 | 90.91 | 84.51 | - 6.40 |
| | | | | 3 | 98.36 | 81.08 | -17.28* |
| | | | | 4 | 96.77 | 86.96 | - 9.81* |
| | 3 | 99.53 | 9.95 | 1 | 103.45 | 90.91 | -12.54* |
| | | | | 2 | 96.77 | 90.91 | - 5.86 |
| | | | | 3 | 96.77 | 92.31 | - 4 46 |
| | | | | 4 | 93.75 | 88.24 | - 5.51 |
| | 4 | 95.69 | 9.57 | 1 | 115.38 | 96.77 | -18.61* |
| | | | | 2 | 93.75 | 89.55 | - 4.20 |
| | | | | 3 | 107.14 | 93.75 | -13.39* |
| | | | | 4 | 101.69 | 93.75 | - 7.94 |
| | 5 | 99.09 | 9.91 | 1 | 103.45 | 85.71 | -17.74* |
| | | | | 2 | 98.36 | 89.55 | - 8.81 |
| | | | | 3 | 105.26 | 83.33 | -21.93* |
| | | | | 4 | 96.77 | 88.24 | - 8.53 |
| | 6 | 97.34 | 9.73 | 1 | 98.36 | 88.24 | -10.12* |
| | | | | 2 | 95.24 | 75.95 | -19.29* |
| | | | | 3 | 96.77 | 86.96 | - 9.81* |
| | | | | 4 | 95.24 | 88.24 | - 7.00 |
| | 7 | 97.85 | 9.79 | 1 | 98.36 | 88.24 | -10.12* |
| | | | | 2 | 101.69 | 90.91 | -10.68* |
| | | | | 3 | 103.45 | 90.91 | -12.54* |
| | | | | 4 | 107.14 | 93.75 | -13.39* |
| | 8 | 95.29 | 9.53 | 1 | 98.36 | 80.00 | -18.36* |
| | | | | 2 | 96.77 | 84.51 | -12.26* |
| | | | | 3 | 100.00 | 85.71 | -14.29* |
| | | | | 4 | 103.45 | 83.33 | -20.12* |
| | 9 | 95.76 | 9.58 | 1 | 100.00 | 88.24 | -11.76* |
| | | | | 2 | 96.77 | 89.55 | - 7.22 |
| | | | | 3 | 100.00 | 88.24 | -11.76* |
| | | | | 4 | 96.77 | 85.71 | -11.06* |
| | 10 | 102.32 | 10.23 | 1 | 109.09 | 85.71 | -23.38* |
| | | | | 2 | 113.21 | 95.24 | -17.97* |
| | | | | 3 | 111.11 | 93.75 | -17.36* |
| | | | | 4 | 103.45 | 88.24 | -15.21* |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| DM | 1 | 56.15 | 5.62 | 1 | 55.56 | 50.85 | - 4.71 |
| | | | | 2 | 60.00 | 57.69 | - 2.31 |
| | | | | 3 | 51.72 | 54.55 | + 2.83 |
| | | | | 4 | 54.55 | 60.00 | + 5.45 |
| | 2 | 56.93 | 5.69 | 1 | 55.56 | 46.88 | - 8.68* |
| | | | | 2 | 56.07 | 56.60 | + 0.53 |
| | | | | 3 | 54.55 | 54.55 | 0 |
| | | | | 4 | 60.00 | 57.69 | - 2.31 |
| | 3 | 52.71 | 5.27 | 1 | 72.29 | 46.15 | -26.14* |
| | | | | 2 | 55.05 | 54.55 | - 0.50 |
| | | | | 3 | 50.85 | 46.15 | - 4.70 |
| | | | | 4 | 50.00 | 51.28 | + 1.28 |
| | 4 | 50.15 | 5.02 | 1 | 50.85 | 47.24 | - 3.61 |
| | | | | 2 | 48.39 | 48.00 | - 0.39 |
| | | | | 3 | 52.63 | 52.63 | 0 |
| | | | | 4 | 50.85 | 45.45 | - 5.40* |
| | 5 | 57.24 | 5.72 | 1 | 53.57 | 53.57 | 0 |
| | | | | 2 | 55.05 | 53.57 | - 1.48 |
| | | | | 3 | 56.07 | 49.18 | - 6.89* |
| | | | | 4 | 51.72 | 50.85 | - 0.87 |
| | 6 | 81.83 | 8.18 | 1 | 81.08 | 75.00 | - 6.08 |
| | | | | 2 | 86.96 | 70.59 | -16.37* |
| | | | | 3 | 88.24 | 76.92 | -11.32* |
| | | | | 4 | 83.33 | 74.07 | - 9.26* |
| | 7 | 63.91 | 6.39 | 1 | 63.16 | 55.56 | - 7.60* |
| | | | | 2 | 62.50 | 55.56 | - 6.94* |
| | | | | 3 | 56.07 | 48.78 | - 7.29* |
| | | | | 4 | 67.42 | 52.17 | -15.25* |
| | 8 | 74.02 | 7.40 | 1 | 85.71 | 66.67 | -19.04* |
| | | | | 2 | 75.95 | 67.42 | - 8.53* |
| | | | | 3 | 95.24 | 61.22 | -34.02* |
| | | | | 4 | 70.59 | 69.77 | - 0.82 |
| | 9 | 61.72 | 6.17 | 1 | 62.50 | 60.00 | - 2.50 |
| | | | | 2 | 68.18 | 60.00 | - 8.18* |
| | | | | 3 | 60.00 | 62.50 | + 2.50 |
| | | | | 4 | 58.82 | 58.82 | 0 |
| | 10 | 67.47 | 6.75 | 1 | 75.00 | 65.22 | - 9.78* |
| | | | | 2 | 84.51 | 72.29 | -12.22* |
| | | | | 3 | 71.43 | 64.52 | - 6.91* |
| | | | | 4 | 74.07 | 65.22 | - 8.85* |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| SR | 1 | 90.02 | 9.00 | 1 | 85.71 | 76.92 | - 8.79 |
| | | | | 2 | 81.08 | 75.00 | - 6.08 |
| | | | | 3 | 103.45 | 85.71 | -17.74* |
| | | | | 4 | 96.77 | 85.71 | -11.06* |
| | 2 | 85.86 | 8.59 | 1 | 83.33 | 81.08 | - 2.25 |
| | | | | 2 | 81.08 | 75.00 | - 6.08 |
| | | | | 3 | 81.08 | 72.29 | - 8.79* |
| | | | | 4 | 86.96 | 71.43 | -15.53* |
| | 3 | 89.11 | 8.91 | 1 | 88.24 | 85.71 | - 2.53 |
| | | | | 2 | 100.00 | 89.55 | -10.45* |
| | | | | 3 | 88.24 | 85.71 | - 2.53 |
| | | | | 4 | 89.55 | 86.96 | - 2.59 |
| | 4 | 87.04 | 8.70 | 1 | 83.33 | 78.95 | - 4.38 |
| | | | | 2 | 83.33 | 80.00 | - 3.33 |
| | | | | 3 | 81.08 | 81.08 | 0 |
| | | | | 4 | 85.71 | 81.08 | - 4.63 |
| | 5 | 82.94 | 8.29 | 1 | 90.91 | 82.19 | - 8.72* |
| | | | | 2 | 90.91 | 85.71 | - 5.20 |
| | | | | 3 | 88.24 | 88.24 | 0 |
| | | | | 4 | 89.55 | 81.08 | - 8.47* |
| | 6 | 77.71 | 7.77 | 1 | 78.95 | 76.92 | - 2.03 |
| | | | | 2 | 76.92 | 73.17 | - 3.75 |
| | | | | 3 | 75.00 | 76.92 | + 1.92 |
| | | | | 4 | 81.08 | 75.95 | - 5.13 |
| | 7 | 82.58 | 8.26 | 1 | 85.71 | 78.95 | - 6.76 |
| | | | | 2 | 95.24 | 68.97 | -26.27* |
| | | | | 3 | 82.19 | 75.95 | - 6.24 |
| | | | | 4 | 85.71 | 75.00 | -10.71* |
| | 8 | 75.91 | 7.59 | 1 | 86.96 | 70.59 | -16.37* |
| | | | | 2 | 84.51 | 67.42 | -17.09* |
| | | | | 3 | 78.95 | 73.17 | - 5.78 |
| | | | | 4 | 88.24 | 69.77 | -18.47* |
| | 9 | 79.73 | 7.97 | 1 | 98.36 | 73.17 | -25.19* |
| | | | | 2 | 90.91 | 75.00 | -15.91* |
| | | | | 3 | 88.24 | 75.00 | -13.24* |
| | | | | 4 | 76.92 | 73.17 | - 3.75 |
| | 10 | 86.38 | 8.64 | 1 | 98.36 | 73.17 | -25.19* |
| | | | | 2 | 83.33 | 77.92 | - 5.41 |
| | | | | 3 | 90.91 | 81.08 | - 9.83* |
| | | | | 4 | 81.08 | 76.92 | - 4.16 |

| Subject | Day | Resting Heart Rate | Decrement | Trial | Before Stimulus | After Stimulus | Difference |
|---|---|---|---|---|---|---|---|
| AS | 1 | 82.62 | 8.26 | 1 | 83.33 | 76.92 | - 6.41 |
| | | | | 2 | 85.71 | 81.08 | - 4.63 |
| | | | | 3 | 83.33 | 78.95 | - 4.38 |
| | | | | 4 | 76.92 | 75.00 | - 1.92 |
| | 2 | 86.69 | 8.67 | 1 | 90.91 | 83.33 | - 3.63 |
| | | | | 2 | 93.75 | 85.71 | - 8.04 |
| | | | | 3 | 88.24 | 83.33 | - 4.91 |
| | | | | 4 | 92.31 | 88.24 | - 4.07 |
| | 3 | 90.51 | 9.05 | 1 | 90.91 | 84.51 | - 6.40 |
| | | | | 2 | 85.71 | 84.51 | - 1.20 |
| | | | | 3 | 95.24 | 81.08 | -14.16* |
| | | | | 4 | 92.31 | 83.33 | - 8.98 |
| | 4 | 76.65 | 7.67 | 1 | 78.95 | 69.77 | - 9.18* |
| | | | | 2 | 82.19 | 75.00 | - 7.19 |
| | | | | 3 | 75.00 | 71.43 | - 3.57 |
| | | | | 4 | 78.95 | 71.43 | - 7.52 |
| | 5 | 83.34 | 8.33 | 1 | 78.95 | 73.17 | - 5.78 |
| | | | | 2 | 81.08 | 77.92 | - 3.16 |
| | | | | 3 | 85.71 | 81.08 | - 4.63 |
| | | | | 4 | 81.08 | 78.95 | - 2.13 |
| | 6 | 91.32 | 9.13 | 1 | 92.31 | 82.19 | -10.12* |
| | | | | 2 | 85.71 | 75.95 | - 9.76* |
| | | | | 3 | 90.91 | 83.33 | - 7.58 |
| | | | | 4 | 90.91 | 80.00 | -10.91* |
| | 7 | 85.82 | 8.58 | 1 | 86.96 | 77.92 | - 9.04* |
| | | | | 2 | 88.24 | 78.95 | - 9.29* |
| | | | | 3 | 82.19 | 77.92 | - 4.27 |
| | | | | 4 | 86.96 | 76.92 | -10.04* |
| | 8 | 84.82 | 8.48 | 1 | 89.55 | 80.00 | - 9.55* |
| | | | | 2 | 86.96 | 80.00 | - 6.96 |
| | | | | 3 | 100.00 | 90.91 | - 9.09* |
| | | | | 4 | 88.24 | 78.95 | - 9.29* |
| | 9 | 78.34 | 7.83 | 1 | 88.24 | 77.92 | -10.32* |
| | | | | 2 | 85.71 | 82.19 | - 3.52 |
| | | | | 3 | 88.24 | 80.00 | - 8.24* |
| | | | | 4 | 89.55 | 83.33 | - 6.22 |
| | 10 | 85.38 | 8.54 | 1 | 88.24 | 80.00 | - 8.24 |
| | | | | 2 | 83.33 | 75.00 | - 8.33 |
| | | | | 3 | 85.71 | 81.08 | - 4.63 |
| | | | | 4 | 90.91 | 82.19 | - 8.72* |

PERSONAL DATA SHEET FOR EXPERIMENTAL GROUP I

| Subject | Age | Height | Weight | Rate of Learning |
|---|---|---|---|---|
| Mary Anderson | 18 years | 68 ins. | 157 lbs. | 9 days |
| Brenda Brooks | 20 | 66 | 120 | 7 |
| Sue Dahl | 19 | 63 | 153 | 6 |
| Sue Finley | 18 | 65 | 180 | 7 |
| Tari Henson | 21 | 65 | 121 | 7 |
| Ellen Horn | 22 | 62 | 147 | * |
| Mary Knazavich | 18 | 69 | 125 | 8 |
| Ricka Levy | 20 | 64 | 140 | 4 |
| Donna Mitchell | 20 | 66 | 136 | 9 |
| Kathy Nagy | 18 | 67 | 130 | * |
| Peg Padula | 22 | 67 | 122 | 3 |
| Kris Patton | 22 | 66 | 127 | 6 |
| Marylou Schick | 21 | 65 | 138 | 7 |
| Kathy Stiegemeier | 19 | 68 | 133 | 5 |
| Sara Wright | 21 | 70 | 135 | 5 |

* Did not reach criterion level for learning

Rate of learning was based upon the ability of the experimental subjects to meet the criterion established for heart rate lowering. This criterion required the subject to lower her heart rate significantly--ten per cent of the mean of her resting heart rate--three of the four trials presented each day, for two consecutive days, while in the sitting position.

PERSONAL DATA SHEET FOR EXPERIMENTAL GROUP II

| Subject | Age | Height | Weight | Rate of Learning |
|---|---|---|---|---|
| B. J. Armstrong | 28 yrs. | 62 ins. | 94 lbs. | 6 days |
| Mary Ann Bandy | 19 | 62 | 130 | 4 |
| Cindy Burke | 20 | 64 | 124 | 6 |
| Carmen Edwards | 22 | 68 | 128 | 6 |
| Cathy Hall | 20 | 69 | 139 | 7 |
| Debbie Lynch | 19 | 66 | 149 | 7 |
| Dean Mathis | 21 | 66 | 162 | 7 |
| Sue Roy | 20 | 61 | 116 | 9 |
| Amy Shook | 19 | 64 | 152 | 7 |

PERSONAL DATA SHEET FOR CONTROL GROUP

| Subject | Age | Height | Weight |
|---|---|---|---|
| Janet (Penny) Barrett | 31 yrs. | 66 ins. | 136 lbs. |
| Connie Comstock | 18 | 67 | 147 |
| Ann Goold | 22 | 63 | 125 |
| Sue Magruder | 19 | 67 | 130 |
| Gail Moses | 21 | 65 | 155 |
| Eva Patton | 18 | 64 | 135 |
| Judi Rueter | 20 | 66 | 203 |
| Linda Roy | 22 | 63 | 105 |
| Linda Stremming | 20 | 65 | 134 |
| Sue Bruemmer | 19 | 69 | 170 |
| Pam Wesner | 19 | 65 | 145 |

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