THE EFFECTS OF AN AEROBIC FITNESS PROGRAM ON PSYCHOLOGICAL WELL-BEING

GARY EDGAR BURT

THE EFFECTS OF AN AEROBIC TRAINING PROGRAM ON PSYCHOLOGICAL WELL-BEING

by

Gary E. Burt, B.Sc.

A Thesis submitted in partial
fulfillment for the degree of
Master of Science

Department of Psychology
Memorial University of Newfoundland
December, 1982

St. John's Newfoundland

ACKNOWLEDGEMENTS

To Dr. Michael J. Stones, my thesis supervisor for his ease in providing helpful criticism, encouragement and good advice. To Drs. Hannah and Preston, thesis committee members, who provided useful and thoughtful feedback. To Drs. Strawbridge and Martin for assistance in computer matters. To the Administration and Staff of the Waterford Hospital for their cooperation and support of continuing education and research. To Bette, for her love, patience and understanding.

ABSTRACT

Exercise and improvements in physical fitness have been found to correlate positively with changes in psychological well-being, particularly with regard to the variables of anxiety and depression. The present investigation attempts to distinguish between central fitness (increased cardio-respiratory functioning) and peripheral fitness (increased strength or flexibility) while considering other factors which may contribute to the psychological improvements often associated with exercise and physical fitness.

Forty-five staff members of a large psychiatric hospital served as subjects for this study. Ages in the sample ranged from 21 to 55 with a mean age of 27.9. Professional and non-professional staff members were evenly represented, as was the sex distribution.

Subjects were randomly assigned to either an Aerobic group (jogging), a Calisthenics group (calisthenics and non-aerobic exercise) or a Recreation group (non-exercise, recreational activity). A Waiting List Control group was also chosen who were not required to participate in any structured activity.

Psychological and physiological measures were taken to evaluate the relative effects of the various conditions. Heart rate (after a standard stepping exercise) and a measure of flexibility served as physical indicators of change while standard tests of depression, trait anxiety and happiness were administered

to assess psychological change. These measures were taken on three separate occasions (pre-program, mid-program and post-program).

As an additional feature, the effect of fitness on state anxiety was evaluated. State measures were taken immediately before and immediately after sessions on three occasions (at the first session, the middle session and at the end).

The experimental program ran for 6 weeks with 3 one-half hour sessions per week (for a total of 18 sessions).

Physical changes occurred as expected. The joggers made the most significant gains in cardio-respiratory fitness while the calisthenics subjects became more flexible. Unexpectedly, all groups (including the Waiting List subjects) improved significantly over time on the psychological measures, but a conditions or interaction effect was not observed. More consistent with earlier work, subjects who became more fit (based on the aerobic indicator) were observed to have greater decreases in state anxiety after engaging in an activity, than those who made marginal or no gains in cardio-respiratory fitness.

The implications of these results were discussed with reference to earlier experimental findings.

Table of Contents

List of Tables

CHAPTER ONE

Improvement in physical fitness has been recognized since the time of ancient Greece as a contributor to psychological health. Indeed, this assumption underlies the current popularization of exercise and the inception of nation-wide advertising campaigns such as Participaction, designed "to get Canadians up and moving" (Sport Participation Canada, 1972).

In industry, it is recognized that improvements in physical fitness of workers may promote increased productivity, significant reductions in absenteeism, as well as worker fatigue and anxiety (Rabb and Gilman, 1964; Donoghue, 1977; Everett, 1979). Exercise programs have also been prescribed as part of a treatment regime for a number of psychological disorders, especially depression (Kostrubala, 1976; Lion, 1978; Greist, 1979).

In spite of the wide acceptance of the notion that physical fitness can promote psychological health, strong empirical support of this relationship appears to be lacking. Researchers have attempted to define the relationship but it is the conclusion of two reviews (Ledwidge, 1980; Folkins and Sime, 1981) that this field of inquiry is in its infancy stage.

The present paper will attempt to distinguish the various forms of exercise and physical fitness and review current theoretical perspectives on how these variables may account for particular

psychological benefits to the individual. Past research findings on the relationship between increased fitness and changes in psychological functioning will also be presented and examined. Finally, an experiment will be described and the results discussed, in which different forms of fitness and activities were examined in relation to their effects on measures of anxiety and depression.

Physical Fitness and Exercise

In making the distinction between types of physical fitness it may be useful to employ the categorizations of central fitness and peripheral fitness. Central fitness refers to improvements in cardio-respiratory functioning or aerobic capacity while peripheral fitness would include such variables as increases in physical strength and flexibility. Exercises which increase the endurance of the cardio-respiratory system include such activities as jogging, cycling and swimming. Peripheral-type changes could be achieved by engaging in activities such as calisthenics and weight-lifting.

Exercise physiologists such as Clarke (1975) regard aerobic capacity as a primary indicator of physical fitness. Moreover, it can be argued that increased aerobic capacity is essential before an individual can derive maximal physical and psychological benefit from exercise. It is only by extending the capacity of the cardio-respiratory system, that an increased

volume of oxygenated blood is delivered to the various organs of the body, including the brain and muscular system (Chapman and Mitchell, 1965).

In trying to determine the psychological effects of increased fitness and exercise, investigators have rarely compared the relative effects of the various types of fitness and exercise. Clearly, the endurance-type or aerobic fitness has received the most attention in the literature (Ledwidge, 1980; Folkins and Sime, 1981).

Theoretical Perspectives

The general framework of research in this area is based on "somatopsychic" theory which posits that bodily functioning exerts a powerful influence on behaviour and psychological functioning (Harris, 1973). Within this framework, three classes of theories have emerged which attempt to explain the positive psychological effects of improved fitness. These theories emphasize either a psychological or a physiological rationale and more recently a model has been proposed which considers cognitive mediation as a superordinate factor (Folkins and Sime, 1981).

Psychological explanations: A variety of speculations have been made on how psychological processes may explain the psychological benefits of increased fitness. Ismail and Tractman (1973) argue that improvements in physical fitness give people a sense of mastery and control, a process later described in a more

general context by Bandura (1977). As the exerciser gains control over his bodily functions and improves body image, it is followed by an increase in self-esteem. It is further assumed that a boost in self-confidence occurs as a result of confronting and overcoming a difficult physical and psychological challenge.

A further psychological explanation is that exercise is a distractor from anxiety-eliciting cognitions (e.g. Morgan, 1979), thereby allowing the opportunity to experience a more positive emotional state.

Ledwidge (1980) considers Seligman's (1972) "learned helplessness" model as a possible explanation for the positive benefits on increased fitness and depression. It is suggested that making an achievement (i.e. getting "in shape") may negate the helpless feeling associated with some depressions and generalize to a recognition that what you do, does bring reinforcement.

Physiological explanations: Ledwidge (1980) provides a comprehensive overview of the physiological models that have been put forth to explain the mental health benefits of exercise. As a general rationale he cites evidence from Selye (1974) and others which suggests that exercise increases the biological adaptation to stress. In this theory, physical stress is synonymous with psychological stress (i.e. a strong emotional reaction and the body's response to a physical stressor are essentially the same on a physiological and neurochemical level).

As an extension of this, it is assumed that just as the individual is more able to contend with physical stress (e.g. physical work) by becoming physically fit, he would have greater ability to deal with psychological stress.

There has been no shortage of more specific physiological models put forth to explain the psychological benefits of increased fitness (Ledwidge, 1980; Folkins and Sime, 1981). However, all are very tentative and lack strong empirical support. This criticism, of course, applies equally well to the psychological theorizing on this relationship.

A Cognitive model: Dissatisfied with the over-simplicity and incompleteness of the theorizing on the positive psychological effects of increased fitness, Folkins and Sime (1981) propose a model for somatopsychic research based on Lazarus' (1975) analysis of the mechanisms underlying biofeedback. It is recognized by these authors that anxiety levels or "somatic turmoil" may be reduced directly by physical fitness training (as in the reduction of muscular action potentials). They also assume that any psychological changes which follow from fitness training are a result of a cognitive appraisal of training effects. Heaps' (1978) data is cited which suggested that the polarity of the cognitive appraisal is influenced by social and psychological variables, rather than on actual physical manisfestations of fitness. For example, he observed that the psychological benefits of exercise

were a function of perceived fitness (based on different forms of feedback to the trainee) than on actual fitness levels. An additional feature of this model is the view that fitness training serves as a coping strategy which helps to regulate the intensity of a stress reaction.

"Feeling Better" with Exercise-Experimental Findings

Research efforts attempting to define the "feeling better" dimension of improved fitness have focused largely on the psychological variables of depression and anxiety (e.g. deVries, 1968; Morgan, Roberts and Feinerman, 1971; Folkins, Lynch and Gardner, 1972; Folkins, 1976; Morgan and Horstman, 1976) and indices of more global concepts such as "life satisfaction" (e.g. Morris and Husman, 1978; Young, 1979).

Improvement in life quality - Morris and Husman (1978) used the Pflaum Life Quality Inventory to compare undergraduates participating in a fitness program with a non-treatment control group. After 19 weeks the experimental group showed significant gains over control subjects in 'life quality' at post testing. The conclusions that can be drawn from this study are somewhat weakened, however, because of its failure to meet the assumptions of randomization in group assignment.

Young (1979) failed to find any change in 'life satisfaction' in his subjects who participated in aerobics training. Positive findings were, however, observed on a measure of health status

and Multiple Affect Adjective Check List (MAACL) (Zuckerman and Lubin, 1965) ratings of anxiety and depression.

Anxiety and depression - Folkins, Lynch and Gardner (1972) observed negative correlations between changes in physical fitness and changes in measures of anxiety and depression (MAACL scores). These authors compared a group of college students who jogged for a semester and a similar group who took part in archery and golf. The greatest benefits, psychologically, were derived by subjects who participated in the aerobic exercise and were less fit at pre-testing.

In a later study by Folkins (1976), significant decreases in anxiety were found in a high risk coronary group who participated in a jogging group, when compared to a non-treatment control group. He failed to find changes in such variables as self-confidence, adjustment and body image. It was concluded that possibly these latter variables are more trait-like and less amenable to change.

McPherson, Paivio, Yuhasz, Rechnitzer, Richard and Lefcoe (1967) investigated the effects of exercise on personality variables and mood states of post-infarct male patients. In this pre-experimental study, the exercising cardiac patients showed more favorable changes on the variety of psychological variables when compared with sedentary cardiac patients, normal exercisers, experienced normal exercisers and sedentary normals.

Based on McPherson et al. (1967), it is the conclusion of the present author that an activity like exercise does make an impact on breaking through the psychological barrier of perceived helplessness often associated with such a condition.

One of the most frequently cited studies regarding the effect of physical activity on anxiety correlates is that of deVries (1968). In two experiments he demonstrated immediate and long-term effects of exercise on EMG activity. In the first experiment subjects participated in a 5-minute bench-stepping exercise, before and after which resting muscle action potential (MAP) was measured. A significant decline in resting MAP was found after exercise in these subjects, with no significant differences noted when the same subjects were measured on a control day (of rest). Long-term effects were observed by testing subjects before and after a 17-week (1 hour per week) program of vigorous exercise. When compared with non-exercising control subjects a significant decrease in MAP was found after termination of the program. These findings have obvious implications for using exercise to moderate at least specific aspects of anxiety responses.

Morgan and Horstman (1976) carried out a series of investigations to evaluate state anxiety, prior to, immediately following, and 20 - 30 minutes following exercise. They found that state anxiety increased during exercise and began to decrease following

exercise. Also, significant decrements below baseline were observed half-way into the recovery period.

A recent study by Stevenson (1980) elaborated on this relationship by evaluating the effect of acute physical activity in individuals with different levels of physical fitness and state anxiety. In this study, subjects scoring high in state anxiety (STAI) (Spielberger, Gorsuch and Lushene, 1970) on pre-test, had a reduction in exercise while low scoring subjects had an increase in anxiety after exercise. Fitness level functioned as a moderating variable, with positive correlations between high levels of fitness and decreases in anxiety while low levels were associated with increases in anxiety or maintenance of pre-examination levels of anxiety.

Summary: The available research is strongly suggestive of psychological benefits being associated with improvements in aerobic fitness. The "feeling better" aspects associated with changes in physical condition have been operationally defined in investigations relating decrements in anxiety and depression to changes in aerobic fitness.

Whether or not significant improvements in 'life quality' follow from increased fitness remains inconclusive. However, positive correlations between increased fitness and affect responses have been demonstrated in several experimental situations. More stable (trait-like) measures as well as state measures

of these variables appear to be influenced by level of physical fitness.

The Present Investigation

The focus of the study described herein was on the evaluation of different types of exercise and activity and their effect on psychological well-being and physical fitness. More than a replication of previous experiments, it combined features of previous studies in an attempt to account for the wide range of variables which could influence psychological functioning in exercise programs. In addition to investigating the intermediate and long term changes associated with three experimental groups and a control group, changes in state anxiety were also evaluated in relation to changes in subjects' level of fitness.

Differential changes in psychological and physical functioning were expected between the jogging (aerobic) group, calisthenics group, recreation (non-exercise) group and waiting list control group over the duration of the program.

It was also expected that subjects participating in aerobic training would show greater decrements in measures of anxiety and depression and greater increases in aerobic capacity, when compared with a calisthenics group, a recreation group and a waiting list control group.

Improvements in psychological functioning were also expected to occur, but to a lesser degree with subjects engaged in the

calisthenics activities. While subjects in this group were not expected to become physically fit (as described above), it was thought that a reduction of muscular tension could possibly decrease anxiety level. In addition, any improvement in body image which may have occurred, would probably enhance a positive view of self. Also, a psychological-positive set was assumed for this condition.

To rule out possible confounding effects of change in daily routine or increased social interaction, a recreation (non-exercise) group was employed. It is reasonable to expect that participants in this group would accrue psychological benefits but less than either of the exercise groups.

In the evaluation of the level of physical fitness on state anxiety, it was expected that as subjects became more fit (aerobically) through participation in a training program, anxiety level should significantly decline following exercise (cf. Stevenson, 1980).

CHAPTER TWO

METHOD

The Setting

The experiment to be outlined was conducted in the context of an exercise and recreation program for staff members at the Waterford Hospital in St. John's, Newfoundland. This is a large psychiatric facility which provides services for approximately 425 chronically ill and acutely disturbed patients. The hospital has 700 staff members, with approximately half of the personnel (nursing, housekeeping and dietary) working on shifts.

The hospital has no specific program in staff development to encourage physical fitness and has limited facilities for staff participation in sport and recreational activities. Only a small number of personnel participate in team sports (floor hockey, bowling and softball) organized by individuals at the hospital.

Subjects

Subject recruitment was initiated by poster advertising in the hospital. These posters described an opportunity for staff members to participate in an 'Exercise and Recreation Program'. Further recruitment was done by making a standard presentation in the various areas of the hospital.

Forty-five volunteers (twenty males and twenty-five females) served as subjects for the present experiment. Ages ranged from 21 to 55 years with a mean age of 27.9 years.

All volunteers were screened for any physical and medical problems which would contraindicate participation in an exertise program.

Since most self-help groups have a significantly high drop-out rate a contracting procedure (Epstein, Wing, Thompson and Griffen, 1980) was employed to minimize subject attrition. Prior to beginning the program, all volunteers were asked to sign a form in which they consented to make a deposit of fifteen dollars. This deposit was then to be returned to the subject at a rate of five dollars at the end of two weeks, if the subject had attended five out of six sessions in that period. The experimenter indicated that any forfeited funds would be donated to a charitable organization to be decided on at a later time.

Materials and Assessment Procedure

Physiological Measures - The Canadian Home Fitness Test (1975) was used to measure cardio-respiratory fitness. This procedure follows recorded instructions which requires the subject to step up and down on a standard set of steps at a constant rate for three minutes. The subjects' pulse rate was then taken and recorded.

Measures of flexibility were obtained by using a modification of the Trunk Forward Flexion Test (The Ministry of State and Amateur Sport, 1979). For this measure, each subject was required to sit barefoot on an exercise mat. Any tight clothing was loosened and the subject's legs were extended flat against the mat with the feet positioned upward at a 90° angle. The subject was then asked to stretch forward as far as possible with arms evenly extended toward his toes. This position was held for about 2 seconds. The procedure was then repeated and the distance of the subject's fingertips from the toes was measured by a standard measuring stick.

Psychological Measures - Changes in subjects' anxiety levels were evaluated with the State Trait Anxiety Inventory (Spielberger et al., 1970). This instrument was useful because general (trait) anxiety could be assessed, as well as immediate changes in state anxiety to treatment procedures.

The Memorial University of Newfoundland Scale of Happiness (MUNSH) (Kozma and Stones, 1979) and the Multiple Affect Adjective Check List (MAACL) (Zuckerman and Lubin, 1965) were used to measure changes in morale and affect.

The MUNSH was originally developed to provide a bi-polar measure of "happiness" in an elderly population. However, Stones (personal communication) indicated that its psychometric strengths are maintained in a more general population. Also, it makes sense

that this measure may correspond to normal fluctuations of mood in non-pathological states of depression and to what Morgan (1971) refers to as the "feeling better" dimension.

The MAACL was also used for its measure of depression. Other investigators (Folkins et al., 1972 and Folkins, 1976) used this instrument in earlier experiments with groups of normal subjects and found it to be a reliable indicator of changes in affective states.

Exercise and Activity Apparatus - Several small exercise mats were provided for subjects participating in the calisthenics group. For participation in the recreation group, subjects were given access to a dart board and darts as well as playing cards and a backgammon set.

Procedure

Subjects were randomly assigned to one of three groups: Aerobic, Calisthenics or Recreation. The Waiting-List Control group was composed of those individuals who were unable to participate in the program at the designated time but indicated that they would participate in a similar program to be held later.

(i) Aerobic - subjects in this group were expected to run or

jog for approximately 20 -- 30 minutes in each session around a 1 kilometer outdoor circular course.

(ii) Calisthenics - an exercise regime consisting entirely of calisthenics exercises was employed in this group. In these sessions, subjects were required to perform a variety of stretching exercises along with push-ups and sit-ups. There were no exercises included which were considered to make any significant change in aerobic capacity. Four members of the Hospital's Physical Education Department alternated as group leader for these sessions.

(iii) Recreation - this was a non-exercise group where members met in either of the rooms adjoining the gymnasium. One of these rooms was designated for subjects to play darts, while the other area was designated for other activities such as card-playing and backgammon. Participants in this group were informed that the activity session was designed for them to take a relaxing break during the work day. They were provided with an option of playing any of the above-mentioned games.

(iv) Waiting-List Control - subjects in this group were not required to attend any special activity group but were tested in the same manner as subjects in the other three groups.

The activity groups were run for six weeks, with three one-half hour sessions per week held during the lunch break.

The program length of some previous studies have typically

been of longer duration. Practical constraints (primarily scheduling and vacations of participants) in the present investigation did not permit extending the number of sessions beyond 18. It was reasoned that if major factors (particularly a significant change in aerobic capacity) were observed in the experimental conditions, an adequate test of the hypotheses could be made. The duration of 6 weeks to test long term effects was also supported by deVries (1968) who found that 17 sessions were sufficient to yield substantive changes in anxiety.

Physical and psychological measures were taken together at three separate times - prior to the beginning of the activity sessions, after three weeks into the program and at the completion of the program. The STAI (state measure) was administered before and after session 1, session 8 or 9 and session 18 to subjects in the Aerobics, Calisthenics and Recreation groups. Subjects in the Waiting-List Control group were not tested on this scale.

CHAPTER THREE

RESULTS

Subject Attrition

From the original fifty-four subjects who agreed to participate in the activity groups, nine decided not to participate before being informed of group assignment. Remaining were thirteen subjects in the Aerobic group, thirteen in the Calisthenics group and ten in the Recreation group. The drop-out rate was then defined as those subjects who failed to attend at least 75% of the sessions. With this criterion, five subjects from the Aerobic group, six from the Calisthenics group and five from the Recreation group were all excluded from the main data analyses. The Waiting-List Control group remained constant at nine subjects throughout the duration of the program.

A chi-square analysis was performed to determine if differences existed between the drop-out rates for the three activity groups. The chi-square value of 1.087 ($p > .05$) indicated no significant differences in attrition between the activity groups.

An informal interview was given to those subjects who dropped out to determine their reasons for discontinuing. Generally, all subjects reported that they derived some form of satisfaction from the experimental conditions. Because of the unpredictability of their work schedules (eg. extended meetings; crises) they were unable to attend at the designated times. One subject who was assigned to the Calisthenics group reported feeling self-consious about her lack of agility subsequently dropped out.

Long Term and Intermediate Effects

Two-way Analyses of Variance (ANOVAS) using unweighted means were performed on each dependent variable. Factors considered were conditions, time of measurement and the interaction effect. These analyses treated seperately each physical measure (central and peripheral fitness) and scores on the psychological measures of happiness (MUNSH), trait anxiety (STAI and MAACL) and depression (MAACL).

I. Central Fitness. Mean heart rate scores (beats/10 seconds) were obtained for subjects in each condition (group) at three measurement times (see Table 1).

The groups effect was not significant ($F = 1.1598$; $df = 3,25$; $p > .10$) but the ANOVA indicated a significant decrease in heart rate over the measurement times ($F = 13.64$; $df = 2,50$; $p < .01$). To determine when these changes occurred the Sheffé method of multiple comparisons (Ferguson, 1971) was used. Significant differences in heart rate scores were found between measurement times 1 and 3 ($F = 26.34$; $df = 2,26$; $p < .01$) and between measurement times 2 and 3 ($F = 14.82$; $df = 2,26$; $p < .01$). There were no significant differences in heart rate scores noted between measurement times 1 and 2 ($F = 1.67$; $df = 2,26$; $p > .05$).

The group x measurement time interaction was also statistically significant ($F = 2.36$; $df = 6,50$; $p < .05$). The F-test for simple effects (multiple comparison procedure) as described in Bruning and Kintz (1968) was performed on the interaction factor. In this procedure each condition is compared with every other condition in terms of the means obtained at the three measurement times.

By using this method, it was observed that subjects in the

aerobic group had greater decreases in heart rate than subjects in the calisthenics group ($F = 8.12$; $df = 2,50$; $p < .01$) and subjects in the Waiting List Control group ($F = 9.17$; $df = 2,50$; $p < .01$). Contrary to expectation there was no significant difference in the rate of decline of heart rate scores between subjects in the Aerobic group and the Recreation group ($F = 3.08$; $df = 2,50$; $p > .05$).

There were no differences in the amount of decline in heart rate between subjects in the Calisthenics group and subjects in the Recreation group ($F = .086$; $df = 2,50$; $p > .05$) or between subjects in the Calisthenics group and the Waiting List Control group ($F = .706$; $df = 2,50$; $p > .05$). Finally, there were no significant differences in the comparison between the Recreation and Waiting List Control group ($F = .682$; $df = 2,50$; $p > .05$).

II. Peripheral Fitness. Mean flexibility ratings for subjects in the four conditions were obtained at three measurement times (See Table 2). No main effects were observed in the ANOVA but there was a significant interaction between conditions and measurement times ($F = 4.0581$; $df = 6,30$; $p < .01$). Through a series of F - tests for simple effects, a statistically significant difference in flexibility ratings was found between the joggers (Aerobic group) and the subjects in the Calisthenics

group over the measurement times ($F = 7.76$; $df = 2,50$; $p < .01$). Note that the joggers became less flexible as the program proceeded while subjects of the Calisthenics group increased over time. A similar relationship was observed when the Calisthenics group was compared to the Recreation group ($F = 7.85$; $df = 2,50$; $p < .01$). Unexpectedly, mean flexibility scores of the Waiting-List Control group did not differ significantly from those of the Calisthenics group ($F = 2.48$; $df = 2,50$; $p > .05$).

Subsequent comparisons within this interaction effect failed to show any significant differences: Aerobics group with Recreation group ($F = 1.4473$; $df = 2,50$; $p > .05$); Aerobic group with Waiting-List Control group ($F = 1.17$; $df = 2,50$; $p > .05$); Recreation group with Waiting-List Control group ($F = 2.24$; $df = 2,50$; $p > .05$).

III. Happiness. Table 3 shows mean happiness ratings (MUNSH) for each group at each measurement period. The main effect of conditions was not significant ($F = .6671$; $df = 3,25$; $p > .10$); nor was the conditions x measurement time ($F = 1.26$; $df = 6,50$; $p > .20$). However, significance was found for the main effect of time of measurement ($F = 7.69$; $df = 2,50$; $p < .01$), indicating a general trend of increased happiness over time.

Sheffé comparisons showed that significant increases in happiness occurred between measurement times 1 and 3 ($F = 14.54$; $df = 2,26$; $p < .01$). No significant differences were noted between

measurement times 1 and 2 ($F = 2.16$; $df = 2,26$; $p > .05$) or measurement times 2 and 3 ($F = 2.73$; $df = 2,26$; $p > .05$).

IV. Depression. There were no significant differences noted in the main effect of conditions (groups) ($F = 1.992$; $df = 3,25$; $p > .1409$) or in the interaction effect of conditions x measurement time ($F = 1.45$; $df = 6,50$; $p > .20$). Significance was observed on the time of measurement factor ($F = 5.69$; $df = 2,50$; $p < .01$). The group means obtained at the three measurement periods are displayed in Table 4.

Multiple comparisons (Sheffé method) showed significant decreases between measurement times 1 and 2 ($F = 11.57$; $df = 2,26$; $p < .01$) and measurement times 1 and 3 ($F = 11.57$; $df = 2,26$; $p < .01$). The means of depression scores taken at measurement times 2 and 3 were identical.

V. Trait Anxiety. Means of anxiety ratings obtained from the MAACL anxiety scale and STAI are displayed in Tables 5 and 6, respectively. The analyses of the MAACL and STAI failed to show a conditions effect or an interaction effect between conditions and time of measurement. The F values for the main effect of conditions for the MAACL and STAI scores were ($F = 2.268$; $df = 3,25$; $p > .10$) and ($F = .441$; $df = 3,25$; $p > .10$), respectively. The interaction effect yielded values of ($F = 1.447$; $df = 6,50$; $p > .20$) for the MAACL and ($F = .747$; $df = 6,50$; $p > .50$) for the STAI.

The main effect of time of measurement was significant for MAACL scores ($F = 5.39$; $df = 2,50$; $p < .01$) as well as the STAI scores ($F = 5.69$; $df = 2,50$; $p < .01$).

The multiple comparisons conducted on the MAACL scores showed significant decreases in anxiety between measurement times 1 and 2 ($F = 7.71$; $df = 2,26$; $p < .05$). The comparisons between measurement times 1 and 3 showed no significant differences in anxiety ratings ($F = 5.99$; $df = 2,26$; $p > .05$). A similar finding was observed in the comparisons of anxiety ratings between measurement times 2 and 3 ($F = .109$; $df = 2,26$; $p > .05$).

The results of the multiple comparisons for the STAI ratings were slightly different. A general decrease in anxiety was found between measurement times 1 and 3 ($F = 13.71$; $df = 2,26$; $p < .01$), but not between measurement times 1 and 2 ($F = .56$; $df = 2,26$; $p > .05$) or measurement times 2 and 3 ($F = 6.56$; $df = 2,26$; $p > .05$).

State Anxiety and Fitness Levels

Differences in heart rate scores between measurement times were calculated for all experimental subjects. Based on the median split of these difference scores, subjects were classified as "improvers" or "non-improvers" ("improvers" were those subjects who had the greatest decreases in heart rate over time while "non-improvers" were those who either had increased, remained the same or decreased only slightly).

Three separate 2-way ANOVAS were conducted which compared the pre and post state measures for the "improvers" and "non-improvers" at the different measurement times. In order to decrease the variance all state anxiety measures were transformed by calculating the square root of each score.

When earlier studies (e.g. Morgan et al., 1971; Stevenson, 1980) investigated the relationship between physical fitness and changes in anxiety level, the effect of other fitness criteria was not considered. For a more complete analysis in the present study it was decided to determine if level of flexibility would have any immediate effects on state measures following an activity.

The analysis of variance procedure was applied to the state measures of "improvers" and "non-improvers" (in flexibility) who had been designated on the basis of a median split of the difference scores of flexibility measures taken at the different measurement times. The same format of analysis was applied to transformed scores as in the foregoing section concerning heart rate scores.

Cardio-respiratory Fitness and Anxiety Level: In the comparison of pre and post session anxiety levels at the first measurement time and at mid-program for "improvers" and "non-improvers", there were no significant interaction effects. The only factor accounting for significant variance was the difference

between state measures taken before sessions and measures following sessions ($F = 6.24$; $df = 1,18$; $p < .05$). Mean transformed anxiety scores at the different conditions are displayed in Table 7.

The comparisons between measures taken at the first session and measures taken at the last session showed that there were significant decreases in anxiety scores at post sessions ($F = 5.22$; $df = 1,18$; $p < .05$). The significant interaction between fitness level and pre-post measures indicated that subjects who improved in fitness between these measurement times had greater decreases in anxiety at post session than those who did not improve ($F = 6.13$; $df = 1,18$; $p < .05$). Table 8 displays mean transformed anxiety scores obtained at measurement times 1 and 3.

Table 9 shows mean transformed scores obtained pre and post sessions at mid-program and at the last session. Overall pre and post measures were significantly different ($F = 15.55$; $df = 1,18$; $p < .01$) but the interaction effect indicated that "improvers" had greater decreases in state anxiety following an activity than the "non-improvers" ($F = 6.23$; $df = 1,18$; $p < .05$).

Flexibility and State Anxiety: Table 10 shows mean transformed anxiety ratings, pre and post session, at the first session and at mid-program for improved and non-improved subjects. There were no significant relationships observed in the analysis of variance between flexibility and change in state anxiety after participating in an activity.

Table 11 shows mean transformed pre and post measures of anxiety for "improvers" and "non-improvers" between sessions one and the last session. Again, no significant relationships were observed between these variables, when considering flexibility levels.

A significant decrease in anxiety at post session was observed overall when measures in mid-program were compared with measures at the end ($F = 9.77$; $df = 1,18$; $p < .01$). However, there were no significant differences between "improvers" and "non-improvers". Table 12 includes mean transformed anxiety ratings used in the foregoing analysis.

Sex and Age

Since the subjects for each condition were randomly selected from a small sample of volunteers there was no attempt made to control for sex and age. With larger numbers the analysis of these variables would be more meaningful and in the present study are of secondary concern to the main hypotheses.

TABLE 1

Mean Heart Rate Scores (Beats/10 sec.) at Three Measurement Times for Ss in Four Conditions

		GROUP			
		AEROBIC	CALIS-THENICS	RECREATION	CONTROL
Measurement Time	Pre-Program	21.88	22.57	21.60	20.56
	Mid-Program	19.13	21.29	21.00	21.60
	Post-Program	17.63	21.00	20.20	20.11

TABLE 2

Mean Flexibility Scores (Inches) at Three Measurement Times for Ss in Four Conditions

		GROUP			
		AEROBIC	CALIS-THENICS	RECREATION	CONTROL
Measurement Time	Pre-Program	2.531	1.214	1.500	1.528
	Mid-Program	2.344	3.107	0.750	2.083
	Post-Program	2.031	3.357	0.500	2.000

TABLE 3

Mean Happiness Scores (MUNSH) at Three Measurement Times for Ss in Four Conditions

		GROUP			
		AEROBIC	CALIS-THENICS	RECREATION	CONTROL
Measurement Time	Pre-Program	16.00	8.71	15.60	14.89
	Mid-Program	17.50	14.29	16.80	15.67
	Post-Program	18.75	17.43	19.20	16.22

TABLE 4

Mean Depression Scores (MAACL) at Three Measurement Times for Ss in Four Conditions

		GROUP			
		AEROBIC	CALIS-THENICS	RECREATION	CONTROL
Measurement Time	Pre-Program	11.88	13.29	8.00	11.78
	Mid-Program	11.25	8.14	4.00	10.67
	Post-Program	9.63	7.71	4.20	10.78

TABLE 5

Mean Anxiety Ratings (MAACL) at Three Measurement Times for Ss in Four Conditions

		GROUP			
		AEROBIC	CALIS-THENICS	RECREATION	CONTROL
Measurement Time	Pre-Program	5.50	6.14	3.40	4.78
	Mid-Program	4.88	3.57	.80	4.11
	Post-Program	4.38	4.00	1.40	4.44

TABLE 6

Mean Anxiety Scores (STAI) at Three Measurement Times for Ss in Four Conditions

		GROUP			
		AEROBIC	CALIS-THENICS	RECREATION	CONTROL
Measurement Time	Pre-Program	33.63	34.29	37.00	35.89
	Mid-Program	34.50	31.86	35.00	36.00
	Post-Program	30.25	31.43	33.80	33.36

TABLE 7

Means and Variance Estimates of Pre and Post Anxiety for Ss who Improved and Non-improved Between Measurement Times I and II on Heart Rate

	FITNESS CRITERIA	
	IMPROVERS	NON-IMPROVERS
Pre-Session	5.68 (.441040)	5.66 (.310165)
Post-Session	5.47 (.245300)	5.36 (.320419)

TABLE 8

Means and Variance Estimates of Pre and Post Anxiety for Ss who Improved and Non-improved Between Measurement Times I and III on Heart Rate

	FITNESS CRITERIA	
	IMPROVERS	NON-IMPROVERS
Pre-Session	5.76 (.586014)	5.59 (.138580)
Post-Session	5.34 (.557709)	5.61 (.32195)

TABLE 9

Means and Variance Estimates of Pre and Post Anxiety for Ss who Improved and Non-improved Between Measurement Times II and III on Heart Rate

	FITNESS CRITERIA	
	IMPROVERS	NON-IMPROVERS
Pre-Session	5.996 (.560623)	5.54 (.257446)
Post-Session	5.36 (.390778)	5.35 (.201141)

TABLE 10

Means and Variance Estimates of Pre and Post Anxiety for Ss who Improved and Non-improved Between Measurement Times I and II on Flexibility

	FITNESS CRITERIA	
	IMPROVERS	NON-IMPROVERS
Pre-Session	5.62 (.552963)	5.71 (.400375)
Post-Session	5.43 (.564102)	5.51 (.359634)

TABLE 11

Means and Variance Estimates of Pre and Post Anxiety for Ss who Improved and Non-improved Between Measurement Times I and III on Flexibility

	FITNESS CRITERIA	
	IMPROVERS	NON-IMPROVERS
Pre-Session	5.56 (.200439)	5.75 (.485336)
Post-Session	5.42 (.341599)	5.51 (.532425)

TABLE 12

Means and Variance Estimates of Pre and Post Anxiety for Ss who Improved and Non-improved Between Measurement Times II and III on Flexibility

	FITNESS CRITERIA	
	IMPROVERS	NON-IMPROVERS
Pre-Session	5.65 (.189041)	5.66 (.537506)
Post-Session	5.37 (.207062)	5.35 (.285187)

CHAPTER FOUR

DISCUSSION

Exercise and improvements in fitness do appear to have some correlation with changes in specific aspects of psychological functioning. The changes observed in the present study, however, were less extensive than expected from the initial hypotheses. Contrary to the suggestions of Ledwidge (1980) and others, increased fitness levels of subjects did not appear to have any noticeable effect on general anxiety and mood states.

The evidence from the studies reviewed here converges to suggest that pervasive changes in psychological functioning may occur as a result of significant improvements in aerobic capacity. It is acknowledged, however, that many of the studies cited were not devised with the rigour which is necessary to make more definitive statements. In the present investigation an attempt was made to strengthen the design by providing tighter controls and making the determination that changes in physical variables did, in fact, occur.

Physical Changes

From Table 1, it is clear that significant changes occurred in cardio-respiratory fitness, with subjects participating in aerobic exercise (jogging) making the greatest gains. The gains made by this group were significantly greater, statistically, than

the Calisthenics and Waiting List Control group, but not the Recreation group. While differences between these two groups were not statistically significant, the trend is in the expected direction.

The change in aerobic capacity of the joggers in the present investigation is consistent with that observed in a number of studies cited by Shephard and Sidney (1978). Many of the training programs were quite vigorous and of longer duration. With an average fitness change of 19% in Aerobic group in the present study, this would appear to reflect "real" improvement for the joggers.

All groups, in fact, were observed to make a significant decrease in heart rate measures over the duration of the program, but not until after mid-program. It is suggested that in spite of the fact that each condition was treated independently, the non-aerobic subjects may have been influenced by the joggers to increase aerobic activities. This is probable in view of the interactions that likely occurred between subjects in different groups either in their work setting or in the experimental environs. An alternate explanation considers the time when the experiment was conducted (during an inter-season between April and June). It is possible that subjects engaged in more exercise outside as the weather improved.

On the measure of flexibility, the Calisthenics group increased more than the remaining groups. Statistically significant differences were observed between the Calisthenics subjects and the joggers and between the Calisthenics subjects and the subjects of the Recreation group. The changes in the Calisthenics group were not significantly different, statistically, from the changes

observed in the Waiting List Control group, but again the changes observed were in the expected direction (see Table 2). The finding of decreased flexibility in the jogging group is not surprising in view of the tightening and constriction which undoubtedly occurred in developing leg muscles of the joggers.

Happiness and Morale

It would appear that improvements in cardio-respiratory fitness make no significant impact on general happiness and morale. The MUNSH (Kozma and Stones, 1980), considered by its authors as a sensitive instrument in measuring changes in happiness, failed to detect any differential changes in either of the experimental groups. While the applicability of this scale could be questioned in view of the original validation sample, the previously used MAACL (Zuckman and Lubin, 1965) also failed to find any greater changes for the aerobic conditioning group when compared with the other groups.

This finding is inconsistent with the findings of Folkins (1976) and Folkins et al. (1972) who observed clear differences between aerobic groups and the control groups on MAACL scales of depression and anxiety. It is possible that the duration of the experimental programs may explain the discrepant findings. The programs referred to in the Folkins' studies occurred over a period of 12 weeks or more. The program in the present investigation lasted for only 6 weeks. If duration of the experimental treatments explains the observed discrepancy, this

would suggest that factors other than or in addition to physical fitness may account for improvement in these particular aspects of psychological functioning, since clear changes in physical fitness were observed in the present study.

That all groups including the Waiting List Control group became happier and less depressed over the course of the program can only be explained on the basis of some form of seasonal variation of mood. A general shift in activity levels and other factors occurring as a result of changes in weather may account for this unexpected finding.

As was previously indicated, subjects became less depressed before mid-program, according to MAACL scores. However, they did not become happier until after mid-program, according to MUNSH scores. The possible inconsistency within these findings may be a product of the different 'states' measured by these two instruments.

Generalized Anxiety

There were decreases in generalized anxiety on the MAACL (anxiety scale) and the STAI for all four groups (see Tables 5 and 6). Again, the possible seasonal variation of mood is put forth as an explanation of these findings.

The rate of decline in general anxiety over the course of the program is different, depending on the anxiety measure which is considered. Based on the MAACL, significant decreases in anxiety were observed before mid-program but remained stable for the

period following. According to STAI measures, anxiety decreased after mid-program and continued to decrease significantly up to the end. The differential rate of change is probably a function of normal variation between the two measures.

Contrary to expectation, the Aerobic group failed to benefit in terms of anxiety reduction any more than the other three groups. The findings of Kowal et al. (1978) indicated significant decreases in generalized anxiety based on the STAI, but the experimental design has been criticized in this instance for failing to meet the random assignment assumption. The discrepancy of the present findings with the Folkins (1972) and Folkins et al. (1976) findings can be treated as a similar discrepancy in the previous section.

Increased Fitness and State Anxiety

Subjects who became more physically fit appeared to have greater decreases in state anxiety following an activity. It is significant that this phenomenon was observed between the periods of greatest change in fitness level (between measurement times 1 and 3 and measurement times 2 and 3). It is also noteworthy that there were no differences observed between the "improvers" and "non-improvers" when state anxiety measures were compared on measurement times 1 and 2 - the interval of least change in physical fitness.

The pre-post changes observed over groups and measurement periods is not too surprising. Subjects in all groups, while participating in the program, were away from a possibly stressful work situation and were engaging in a diversional and relatively unstressful activity.

The findings of the present investigation are consistent with Stevenson's (1980) data but address a more interesting question. In her study, Stevenson (1980) classified her subjects on the basis of (a) fitness level and (b) pre-exercise anxiety levels from measures taken at a single measurement period. In the present study it was possible to evaluate the relationship of increased fitness with state anxiety in subjects who became more physically fit over time.

The post hoc analysis of flexibility ratings and state anxiety failed to yield any significant relationships between these variables. This would support the notion held by Ledwidge (1980) and others that the greatest psychological benefits may be derived from oxygen-consuming exercise over other forms of exercise.

The evidence is quite strong from the foregoing discussion that exercise and increased fitness (aerobic) is associated with improvements in psychological functioning. Morgan (1979) suggests that the anxiety reduction which follows vigorous physical activity

could have important implications for the mental health of individuals. While long-term psychological effects may not be demonstrated, the acute effects of exercise could provide symptomatic relief from tension and anxiety. Anxiety levels may gradually increase after the immediate dealine but the subject becomes aware that relief can be obtained by further exercise. As the data presented here suggests, the individual would not derive much benefit until after achieving a significant improvement level in aerobic fitness.

The present study was not designed to determine the mechanism responsible for the psychological benefits of exercise. It would seem reasonably clear, however, that physical change alone, is not the sole factor, particularly with regard to any long term benefits, unless an optimal fitness level is necessary before psychological changes are observed.

It is possible that only after a significant period of clearly observed physical and emotional improvements by the subject would an attributional process occur to account for improved affects. At the same time, the individual may be receiving increased social reinforcement, and organizing his world more systematically by engaging in regular exercise.

Future investigations of this nature would be worthwhile to consider the length of the experimental program, while

minimizing drop-out rates by providing more compelling incentives to attend (e.g. time off from work). In the present study attrition rates for each group were not significantly different, but the overall numbers for the purpose of analysis were still relatively small.

Still more rigorous controls might be introduced by determining (through subject interviews) the amount of physical activity that subjects engaged in while on their own time. This would help to account for unexpected increases in aerobic capacity and psychological well-being (of non-aerobic subjects), as observed in the present study. This could also apply to making a determination of subjects' pre-experimental patterns of physical activity. In addition, the variables of weight loss and changes in body measurements should be considered.

REFERENCES

Bandura, A. Self-efficacy: Toward a unifying theory of behavioural change. Psychological Review, 1977, 84, 191 - 215.

Bruning, J. L. and Kintz, B. L. Computational Handbook of Statistics. Glenview, Illinois: Scott, Foreman and Company, 1968.

Chapman, C. B. and Mitchell, J. H. The Physiology of Exercise. Scientific American, 1965, 212(5), 88 - 96.

Clarke, D. H. Exercise Physiology. Englewood Cliffs, N. J.: Prentice-Hall, 1975.

de Vries, H. A. Immediate and Long Term Effects of Exercise Upon Resting Muscle Action Potential Level. Journal of Sports Medicine, 1968, 8, 1 - 11.

Donoghue, S. The correlation between physical fitness, absenteeism and work performance. Canadian Journal of Public Health, 1977, 68, 201 - 203.

Epstein, L. H., Wing, R. R., Thompson, T. K. and Griffen, W. Attendance and Fitness in Aerobics Exercise: The Effects of Contract and Lottery Procedures. Behaviour Modification, 1980, 4(4), 465 - 479.

Everett, M. D. Strategies for Increasing Employees' Level of Exercise and Physical Fitness. Journal of Occupational Medicine, 1979, 21(7), 463 - 467.

Ferguson, G. A. Statistical Analysis in Psychology and Education (3rd Edition). New York, N. Y.: McGraw-Hill, 1971.

Folkins, C. H. Effects of physical training on mood. Journal of Clinical Psychology, 1976, 32, 385 - 388.

Folkins, C.H., Lynch, S., and Gardner, M. M. Psychological fitness as a function of physical fitness. Archives of Physical Medicine and Rehabilitation, 1972, 53, 503 - 508.

Folkins, C. H. and Sime, W. E. Physical Fitness Training and Mental Health. American Psychologist. 1981, 36(4), 373 - 389.

Greist, J. H., Klain, M. H., Eischens, R. R., Faris, J. W., Gurman, A. S. and Morgan, W. P. Running as treatment for depression. Comprehensive Psychiatry, 1979, 20, 41 - 54.

Harris, D. V. Involvement in Sports: A somatopsychic rationale for physical activity. Philadelphia, Pa.: Lea & Febiger, 1973.

Heaps, R.A. Relating physical and psychological fitness: A psychological point of view. Journal of Sports Medicine and Physical Fitness, 1978, 18, 399 - 408.

Kostrubala, T. The joy of running. Philadelphia: Lippincott, 1976.

Kowal, D. M., Patton, J. F., and Vogel, J. A. Psychological states and aerobic fitness of male and female recruits before and after basic training. Aviation, Space and Environmental Medicine, 1978, 49, 603 - 606.

Kozma, A., and Stones, M. J. The Measurement of Happiness: Development of the Memorial University of Newfoundland Scale of Happiness (MUNSH). Journal of Gerontology, 1980, 35, 906 - 912.

Lazarus, R. S. A cognitively oriented psychologist looks at biofeedback. American Psychologist. 1975, 30, 553 - 561.

Ledwidge, B. Run for your mind: Aerobic exercise as a means of alleviating anxiety and depression. Canadian Journal of Behavioural Science, 1980, 12(2), 126 - 140.

Lion, L. S. Psychological effects of jogging: a preliminary study. Perceptual and Motor Skills, 1978, 47, 1215 - 1218.

McPherson, B. D., Paivio, A., Yuhasz, M. S., Rechnitzer, P. A., Pickard, H. A., and Lefcoe, N. B. Psychological effects of an exercise program for postinfarct and normal adult men. Journal of Sports Medicine and Physical Fitness, 1967, 7, 95 - 102.

Morgan, W. P. Anxiety reduction following acute physical activity. Psychiatric Annals, 1979, 9, 141 - 147.

Morgan, W. P., and Horstman, D. H. Anxiety reduction following acute physical activity. Medicine and Science in Sports, 1976, 8, 62.

Morgan, W. P., Roberts, J. A. and Feinerman, A. D. Psychological effect of chronic physical activity. Medicine and Science in Sports, 1971, 2, 213 - 217.

Morris, A. F., and Husman, B. F. Life quality changes following an endurance conditioning program. American Corrective Therapy Journal, 1978, 32, 3 - 6.

Rabb, W., and Gilman, S. B. Insurance Sponsored Preventative Cardiac Reconditioning Centres in West Germany. American Journal of Cardiology, 1964, 13: 670 - 3.

Seligman, M. E. P. Learned helplessness. Annual Review of Medicine, 1972, 23, 407 - 412.

Selye, H. Stress without distress. Toronto: McClelland and Stewart, 1974.

Spielberger, C. D., Gorsuch, R. L., and Lushene, R. E. Manual for the State-Trait Anxiety Inventory. Palo Alto, Calif.: Consulting Psychologists Press, 1970.

Standardized Test of Fitness. Operations Manual The Ministry of State and Amateur Sport, Ottawa, 1979.

Stevenson, S.A. The relationship between state anxiety, level of physical fitness and acute physical activity. Unpublished Honors Dissertation, MUN, 1980.

The Canadian Home Fitness Test. Health and Welfare Canada, 1975.

The Canadian movement for personal fitness. Sport Participation Canada. Pamphlet, Copyright, 1972.

White, J. A., Ismail, A. H. and Bottoms, G. D. Effect of physical fitness on the adrenocortical response to exercise stress. Medicine and Science in Sports, 1976, 8, 113 - 118.

Young, R. J. The effect of regular exercise on cognitive functioning and personality. British Journal of Sports Medicine, 1979, 13, 110 - 117.

Zuckerman, M. and Lubin, B.: Manual for Multiple Affect Adjective Check List. San Diego, Educational and Industrial Testing Service, 1965.

APPENDIX A

Analysis of Variance Tables

1. Mean Heart Rate Scores for Four Conditions over Three Measurement Times

Source	DF	Sum of Squares	Mean Square	F
Conditions	3	46.0408	15.3469	1.1598
Time of Measure	2	56.0043	28.0021	13.6426
Interaction	6	29.1127	4.8521	2.3639

2. Mean Flexibility Scores for Four Conditions over Three Measurement Times

Source	DF	Sum of Squares	Mean Square	F
Conditions	3	32.4136	10.8045	0.3575
Time of Measure	2	2.1204	1.0602	1.1365
Interaction	6	22.7137	3.7856	4.0581

3. Mean Happiness Scores (MUNSH) for Four Conditions over Three Measurement Times

Source	DF	Sum of Squares	Mean Square	F
Conditions	3	206.3835	68.7945	0.6671
Time of Measure	2	233.0389	116.5194	7.6928
Interaction	6	114.9051	19.1508	1.2644

4. Mean Anxiety Scores (MAACL) for Four Conditions over Three Measurement Times

Source	DF	Sum of Squares	Mean Square	F
Conditions	3	122.3978	40.7993	1.9920
Time of Measure	2	42.5398	21.2699	5.3945
Interaction	6	15.2196	2.5366	0.6433

5. Mean Depression Scores (MAACL) for Four Conditions over Three Measurement Times

Source	DF	Sum of Squares	Mean Square	F
Conditions	3	438.1637	146.0546	2.2676
Time of Measure	2	161.6012	80.8006	10.7551
Interaction	6	65.2274	10.8712	1.4470

6. Mean Anxiety Scores (STAI) for Four Conditions over Three Measurement Times

Source	DF	Sum of Squares	Mean Square	F
Conditions	3	135.6285	45.2095	0.4405
Time of Measure	2	126.4034	63.2017	5.6862
Interaction	6	38.4324	6.4054	0.5763

7. Means of Pre and Post Anxiety Scores for Ss who Improved and Non-improved Between Measurement Times I and II on Heart Rate

Source	DF	Sum of Squares	Mean Square	F
Heart Rate (Improved/non-improved)	1	.00648	.00648	.1401
Measurement Session (I - II)	1	.00132	.00132	.00298
Measurement Time (Pre-Post)	1	1.4445	1.4445	6.243
Interaction (Measurement Time x Heart Rate)	1	.00409	.00409	.1766

8. Means of Pre and Post Anxiety Scores for Ss who Improved and Non-improved Between Measurement Times I and III on Heart Rate

Source	DF	Sum of Squares	Mean Square	F
Heart Rate (Improved/Non-improved)	1	.00583	.00583	.00996
Measurement Session (I - III)	1	.35445	.35445	.39259
Measurement Time (Pre-Post)	1	.81709	.81709	5.226
Interaction (Measurement Time x Heart Rate)	1	.95769	.95769	6.1255

9. Means of Pre and Post Anxiety Scores for Ss who Improved and Non-improved Between Measurement Times II and III on Heart Rate

Source	DF	Sum of Squares	Mean Square	F
Heart Rate (Improved/Non-improved)	1	.8686	.8686	1.1574
Measurement Session (II - III)	1	.01109	.01109	.00209
Measurement Time (Pre-Post)	1	2.1060	2.1060	15.5527
Interaction (Measurement Time x Heart Rate)	1	.84421	.84421	6.2345

10. Means of Pre and Post Anxiety Scores for Ss who Improved and Non-improved Between Measurement Times I and II on Flexibility.

Source	DF	Sum of Squares	Mean Square	F
Heart Rate (Improved/Non-improved)	1	.14365	.14365	.2321
Measurement Session (I - II)	1	.00256	.00256	.00249
Measurement Time (Pre-Post)	1	.74691	.74691	3.7435
Interaction (Measurement Time x Heart Rate)	1	.00105	.00105	.5278

11. Means of Pre and Post Anxiety Scores for Ss who Improved and Non-improved Between Measurement Times I and III on Flexibility

Source	DF	Sum of Squares	Mean Square	F
Heart Rate (Improved/non-improved)	1	.3985	.3985	.70023
Measurement Session (I - III)	1	.3578	.3578	.40230
Measurement Time (Pre-Post)	1	.81406	.81406	4.0492
Interaction (Measurement Time x Heart Rate)	1	.00458	.00458	.22794

12. Means of Pre and Post Anxiety Scores for Ss who Improved and Non-improved Between Measurement Times II and III on Flexibility

Source	DF	Sum of Squares	Mean Square	F
Heart Rate (Improved/Non-improved)	1	.00546	.00546	.0067
Measurement Session (II - III)	1	.00256	.00256	.0088
Measurement Time (Pre-Post)	1	1.8000	1.8000	9.7672
Interaction (Measurement Time x Heart Rate)	1	.00924	.00924	.00251