THE DEVELOPMENT OF A PSYCHOBIOLOGIC PROFILE OF INDIVIDUALS
WHO EXPERIENCE AND THOSE WHO DO NOT EXPERIENCE
EXERCISE-RELATED MOOD-ENHANCEMENT

DISSERTATION

Presented to the Graduate Council of the
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By

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The present investigation involved the development of a psychobiologic profile of individuals who experience exercise-related mood-enhancement and those who do not. The sample (N=301) consisted of students participating in 10-week exercise classes at North Texas State University. All subjects completed pre-test inventories assessing various psychological (i.e., trait anxiety and depression, attitude toward physical activity, self-estimation of physical ability and attraction to physical activity, expectancies of health benefits from exercise, and self-motivation) and biological (i.e., aerobic capacity and body fat percentage) variables. Trait anxiety and depression were also assessed before and after the 10-week exercise program and state anxiety and depression were assessed on an acute basis on two separate occasions during the program. Multivariate analysis of variance and discriminant function analysis were employed to determine which variables maximally discriminated between individuals who experienced mood-elevations following exercise and those who did not.
enjoy such rewards. The hypothesis that these two groups of individuals differ significantly from each other was not upheld by the results; thus, an overall psychobiologic profile could not be developed. However, the data did reveal that individuals who held a more positive attitude toward physical activity for the purpose of health and fitness reduced their state anxiety and depression following exercise significantly more than individuals who held more neutral attitudes. The results also confirmed previous research that individuals initially high in trait anxiety and depression showed a significantly greater decrease in these traits than subjects scoring in the low-moderate range at the outset of the exercise class. Recommendations for future research are discussed.
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CHAPTER I

INTRODUCTION

The recent release of statistics citing the high incidence of heart disease in the United States has prompted a resurgence of health consciousness among Americans. Lifestyle changes including healthier eating and exercise habits are demonstrated by the sudden increase of nutritional cookbooks appearing on bookstore shelves and the record number of fitness fanatics appearing in health clubs. This phenomenon has spawned a plethora of studies investigating the motives of people to engage in strenuous activities (Carmack & Martens, 1979; Cooper, 1977) as well as the physiological (Sharkey, 1979; Ulyott, 1980) and psychological (Ismail & Young, 1977; Morgan, 1981) consequences of participation.

The physiological benefits of exercise are well-documented. Substantial evidence indicates that vigorous physical activity performed on a regular basis will aid in the reduction of elevated blood lipids, body fat, hypertension, obesity and pulse rate as well as increase lean body mass, high-density lipoproteins, stroke volume, and maximal oxygen uptake (Barnard, 1975; Barnard, Weber, Weingarten, Bennett, & Pritikin, 1981; Sharkey, 1979). In fact, the National Institute of Health (1981) estimates that
cardiovascular disease has declined by 25% in the past decade due in part to an increase in daily exercise among formerly inactive individuals.

Recently, however, it has been indicated that not only does one's physical health benefit from regular exercise but also one's mental health (Heaps, 1978; Ledwidge, 1980; Sachs & Buffone, 1984). Earlier anecdotal reports of post-exercise positive affect have been confirmed by numerous scientific investigations (Carmack & Martens, 1979; Morgan, 1981, Young & Ismail, 1976). Specifically, exercise appears to have a tranquilizing and antidepressant effect on participants; thus, anxiety and depression have been the two variables receiving the most scientific attention (Berger, 1984b; Morgan, 1981).

Before the research can be evaluated, however, it is important to differentiate between states and traits of both anxiety and depression. State anxiety is a transitory reaction usually following a perceived threat or stress and is accompanied by an increased heart rate, blood pressure and respiration rate. Trait anxiety, however, is a relatively stable personality trait characterized by a tendency to respond to many situations with state anxiety reactions (Spielberger, 1966).

Depression may be thought of in a similar manner. That is, depression as a state may be an immediate reaction to a gloomy situation whereas depression as a trait may be
a more serious, long-term response of a neurotic or psychotic nature (Greist, Klein, Eischens, & Faris, 1979).

Exercise effects must also be classified into two different categories: acute and chronic. Acute refers to the immediate, transitory effects arising from a single bout of exertion. By contrast, chronic effects are more enduring or long-term and result from exercise performed frequently and consistently over the course of several weeks, at least.

Studies investigating acute effects suggest that exercise is effective in reducing state anxiety and depression (Bahrke & Morgan, 1978; Byrd, 1964; Wilson, Berger, & Bird, 1981). These effects are transient, however, and exercise must be repeated on a consistent basis for continued mood-enhancement.

Studies of chronic exercise also suggest that improvements in mental health accompany improvements in physical health. However, these results must be qualified by several factors. An individual's initial physical and psychological condition, the intensity of the exercise, and the type of exercise are all limiting factors of positive chronic effects.

Despite some methodological design flaws plaguing research in this area, the volume of studies suggesting positive psychological consequences resulting from vigorous physical activity is impressive. This psychobiologic or "mind-body" interdependence has been studied recently with
regards to exercise adherence (Dishman, 1984a, 1984b; Dishman & Gettman, 1980). The high rate of dropout from exercise programs suggests that dropouts and adherers may be experiencing different effects from their participation in exercise. Since claims of post-exercise mood-elevation can be expressed only by individuals who exercise, then perhaps those individuals who drop out of exercise are those who do not experience the tranquilizing and antidepressant effects. Specifically, it is possible that those individuals who experience positive affect may be continuing with their programs whereas those who do not enjoy post-exercise mood-enhancement may drop out.

**Statement of the Problem**

The numerous benefits of consistent physical activity are not accrued by a large portion of the United States population due to the high dropout rate from exercise classes. Since only adherers have provided data attesting to post-exercise mood-enhancement, it is possible that dropouts discontinued their exercise due to the absence of these positive psychological effects. Research to date, however, has not identified those individuals who do and do not experience post-exercise mood-elevation.

**Purpose of the Study**

The purpose of the present investigation was to develop a psychobiologic profile of individuals who experience and
those who did not experience the mood-enhancing effect of exercise on an acute and chronic level.

**Significance of the Study**

The fact that regular exercise is part of a healthy lifestyle is undisputed; nevertheless, more than 50% of the United States population does not participate in this potentially valuable activity. Although exercise participants enthusiastically confirm that exercise "makes them feel better psychologically," comparisons with exercise dropouts cannot be made since they are no longer accessible. It is suggested that exercise dropouts may not be experiencing the same mood elevations as their exercising counterparts. If this is so, a method of identifying people who do not "feel good" after exercise would greatly aid program directors in targeting strategies to promote adherence. Therein lies the significance of this study.

**Definition of Terms**

Below are definitions of terms used in the present investigation.

- **Acute (state):** Exercise effects which are immediate and transitory; short-term.

- **Chronic (trait):** Exercise effects which are enduring or persistent; long-term.

- **Psychobiologic:** Pertaining to both somatic and cognitive; mind-body interdependence.
**Anxiety:** Fear or apprehension of some perceived threat or stress; may be associated with increased autonomic nervous system activity.

**Depression:** Generalized feelings of hopelessness, despair, sadness, self-hate and pessimism.
CHAPTER REFERENCES


CHAPTER II

REVIEW OF LITERATURE

In response to the alarming increase in the incidence of heart disease as well as a desire to look and feel good, Americans have recently become more concerned and in some cases even obsessed with physical fitness. Running is perhaps the most convincing testimony of this obsession as runners are appearing in record numbers along roadways throughout the country. This phenomenon has spawned a plethora of studies investigating the motives of runners to engage in and/or persist at this activity.

The physiological effects of exercise have been studied exhaustively and are now well-documented (e.g., Barnard, Weber, Weingarten, Bennett, & Pritikin, 1981; Cooper, 1977; Sharkey, 1976; Ullyot, 1980). Evidence indicates that regular, vigorous physical activity is effective in reducing elevated blood lipids, body fat, hypertension, obesity and pulse rate as well as increasing lean body mass, high-density lipoproteins, cardiac stroke volume and maximal oxygen uptake (Barnard; 1975; Holloszy, Skinner, Toro, & Cureton, 1964; Oscai, Patterson, Bogard, Beck, & Rothermel, 1972; Sharkey, 1979). Indeed, statistics reveal that cardiovascular disease has declined by 25% in
the past decade partly due to an increase in daily exercise among the formerly sedentary (National Institute of Health, 1981).

Such improvements in cardiovascular health are not the result of a few minutes of mild exercise engaged in on an occasional basis, however. Physiologists note that exercise must be a specific frequency (i.e., 3-4 days/week), intensity (i.e., 60-85% of maximal heart rate), and duration (i.e., 12-20 minutes) in order for the cardiovascular system to become stronger and more efficient (e.g., Astrand & Rodahl, 1977; Cooper, 1977; Sharkey, 1979). Specific times and percentages will vary depending on the individual's fitness level and age.

Recent research indicates, however, that not only does one's physical health benefit from chronic exercise but also one's mental health (Heaps, 1978; Ledwidge, 1980; Sachs & Buffone, 1984). Although earlier evidence was largely anecdotal in nature, numerous studies have since been conducted to corroborate these reports scientifically. Though not unequivocal, an impressive majority of results confirm the hypothesis that vigorous exercise has a mood-elevating effect (Carmack & Martens, 1979; Morgan, 1981; Sime, 1977; Young & Ismail, 1976).

Despite a variety of individual responses, the evidence indicates that the majority of runners begin running for health-related reasons (e.g., weight control, general
physical fitness), yet their motivation to continue running stems largely from positive psychological sensations experienced following a strenuous workout (Carmack & Martens, 1979; Cooper, 1977; Dishman & Gettman, 1980; Greist, Klein, Eischens, & Faris, 1978; Kostrubala, 1977; Sharkey, 1979; Ullyot, 1980). Indeed, committed runners often report negative affect when circumstances beyond their control force them to miss their regular run (Glasser, 1976; Morgan, 1979; Sachs & Pargman, 1979).

The ensuing paper focuses on the psychological effects resulting from vigorous physical activity including the benefits of exercise, variables mediating the exercise-“feel good” relationship, and a brief account of some current theories proposed to explain the mechanisms underlying post-exercise mood-enhancement. A psychobiologic approach is then discussed with regards to related research in this area and used to propose a prediction equation for exercise and psychological well-being.

Psychological Consequences of Exercise

Exercise-induced mental health enhancements have been reported in the literature in various forms. For example, self-confidence (Ismail & Trachtman, 1973; Johnson, 1962), body image (Holden, 1962), intelligence (Dulberg & Bennett, 1980; Jones & Weinhouse, 1979), self-concept (Hilyer & Mitchell, 1979), imaginativeness and emotional stability
(Ismail & Trachtman, 1973; Jasnoski & Holmes, 1981; Young & Ismail, 1976) have all been shown to increase with physical training. In addition, below average levels of confusion and hostility have been associated with physical activity and/or highly trained individuals (Berger & Owen, 1983; Morgan, 1982; Morgan & Pollock, 1977; Pistacchio, 1984) as well as a high level of vigor (Berger & Owen, 1983; Morgan, 1982; Morgan & Pollock, 1977).

Perhaps the two psychological variables most frequently tested in association with physical activity are anxiety and depression. Despite a variety of methodological problems inherent in assessing these two variables, the vast majority of results lead to similar conclusions; i.e., anxiety and depression are reduced following physical activity (Berger, 1984b; Morgan, 1981). However, in order to critically evaluate the findings of these studies, it is first necessary to define anxiety and depression in terms of states and traits.

Spielberger (1970) has defined state anxiety (A-state) as a transitory reaction usually occurring in response to an immediately perceived threat or stress and is manifested by increased heart rate, respiration rate, galvanic skin response, etc. By contrast, trait anxiety (A-trait) is a relatively stable personality disposition characterized by a tendency to respond to a wide range of objectively non-
threatening situations with state anxiety reactions disproportionate in magnitude to the perceived stress.

Although not defined as such, depression can be conceptualized in a similar fashion. That is, depression as a state is a normal response ranging from everyday "blues" to grief, possibly stemming from a morbid situation and dissipating as the offending situation is resolved. Depression as a trait may be a more serious affliction ranging from moderate (neurotic-reactive) to severe (endogenous-psychotic) and does not lessen within a reasonable time period (Greist, Klein, Eischens, & Paris, 1979).

Research exploring the effects of exercise has been divided between state anxiety and depression in normal or non-clinical populations and more severe forms such as anxiety neurosis and psychotic depression in clinical populations. These distinctions will be noted where appropriate throughout the ensuing paper.

It is also necessary to differentiate between acute and chronic exercise effects. Acute refers to immediate and possibly, but not necessarily, transitory effects arising from a single bout of exertion. By contrast, chronic effects are the result of exercise performed on a regular basis over the course of several weeks, with 5 weeks typically considered a minimum. Thus, chronic effects can be regarded as more enduring or long-term.
Acute Effects

Although research on the physiological consequences of acute exercise is extensive (Edington & Edgerton, 1976; Sharkey, 1979), there have been relatively few investigations examining acute effects from a psychological perspective (e.g., Berger, 1984a; Morgan, 1976, 1981). The limited psychological research that does exist has been primarily concerned with anxiety and only a few isolated studies dealing with other aspects of mental health.

Byrd (1964) was one of the first researchers to investigate the influence of physical activity on anxiety. State anxiety was assessed by a self-report measure and was shown to decrease following bowling. Neither placebo or control groups were employed however, and subsequent studies suggested that the observed reduction in anxiety was probably due to the diversionary aspect associated with bowling rather than the exercise that bowling provided (Morgan, 1982).

Twenty-four years later Bahrke and Morgan (1978) produced similar results from a different design. They found that exercise of 70% intensity, non-cultic meditation, and simple quiet rest were all equally effective in reducing state anxiety. This finding supported that of Byrd (1964) and the authors suggested that exercise per se does not produce relaxation but it is the "time out" or respite from daily stresses that promotes the resultant calm.
More recently, Wilson, Berger and Bird (1981) added support to the "time out" hypothesis (Bahrke & Morgan, 1978) when their findings revealed that subjects in a running group, an exercise class, and a group eating lunch all had equally significant decreases in state anxiety following their respective activity. The authors concurred with the conclusion drawn by Bahrke and Morgan (1978) that diversionary factors may have been operative to produce such similar changes in anxiety scores.

Results from the above three studies suggest that the exertion component of exercise has little to do with the consequent sense of relaxation reported by subjects. However, Morgan, Roberts, and Feinerman (1971) had previously tested exertion directly and observed conflicting results. They randomly assigned subjects to exercise groups walking 1 mile on a treadmill at 3.5 mph at either a 0% grade (level surface) or a 5% grade. The data failed to produce a significant decrease in anxiety in either exercise group when assessed by the IPAT 8-Parallel-Anxiety-Battery. In addition, Sime (1977) later replicated these findings using the STAI for assessing state anxiety (Morgan, 1980).

A series of other investigations (Morgan, 1973, 1976; Morgan, Horstman, Cymerman, & Stokes, 1980), however, have indicated significant decrements in state anxiety following exercise at intensities ranging from 70% to 80% of maximal aerobic capacity. Results of these studies have led
researchers to suggest that exercise must be of sufficient intensity to promote a relaxation effect.

Collective findings from the above studies have led to the conclusion that aerobic exercise is indeed necessary for the alleviation of state anxiety. Due to its popularity and accessibility, running has been the aerobic activity most often tested in field experiments (e.g., Driscoll, 1976; Tooman & Harris, n.d.). For example, Pistacchio (1984) found a significant reduction in anxiety, depression, and hostility in college-aged females following running and aerobic dance. Seventy subjects were administered the Profile of Mood States (POMS) (McNair, Loor, & Droppleman, 1971) before and after exercise on three separate occasions during a 5-week conditioning program. The aerobic exercise consisted of 25 minutes of either running or aerobic dancing at 70% to 85% of each subject's maximal heart rates. The intensity of the exercise was confirmed by each subject monitoring her own pulse rate. Highly significant acute reductions were noted in all three variables on all three occasions for both running and aerobic dance.

Berger and Owen (1983) corroborated Pistacchio's results with a unique study using swimming as the aerobic activity. The authors reported that swimmers felt significantly less anxious, depressed, hostile, and confused and significantly more vigorous after swimming than before as assessed by the POMS.
Although the results of the last eight studies strongly suggest that aerobic exercise specifically is necessary for post-exercise mood-elevation, they nevertheless conflict with findings cited earlier by Byrd (1964), Bahrke and Morgan (1978), and Wilson, Berger and Bird (1981), all of whom found that exercise intensity was not a determining factor of mood-enhancement. Additionally, the term "aerobic" implies a minimum duration (i.e., 12-15 minutes) as well as a minimum intensity, yet research to date has not discussed the duration component as a determinant of acute psychological states. Future research should focus on these two components to determine if either or both are vital to post-exercise affect.

The next three studies employed physiological techniques to measure state anxiety following an acute bout of exercise. For example, de Vries (1968) used electromyography (EMG) to assess tension via integrated muscle action potentials in various muscle groups. The results indicated that muscle tension was significantly lower following exercise. Further, a follow-up study revealed that vigorous exercise was superior to a frequently prescribed tranquilizer (i.e., meprobamate) in reducing tension (de Vries & Adams, 1972). This finding sparked interest in the use of exercise as an alternative to pharmacological agents prescribed to induce relaxation (e.g., Lion, 1978).
In contrast to de Vries' (1968) findings, however, Tooman and Harris (n.d.) reported that reductions in anxiety as measured by the STAI following the subjects' daily run were not reflected by reductions in muscle action potentials when measured electromyographically. That is, muscular tension as assessed by EMG was not reduced concomitantly with reductions in mental tension as assessed by STAI. A mood-enhancing effect was noted, however, on all six scales of POMS (i.e., anxiety, depression, hostility, confusion, fatigue, and vigor). No explanation was reported for this apparent discrepancy among psychological assessments of anxiety.

Thus, physiological studies using EMG to assess tension are also equivocal and therefore do not help resolve the question of exercise intensity and subsequent mood-elevation. This is an issue which requires further scientific attention.

Finally, an attempt was made to quantify the time course of anxiety reduction following acute exercise. Seemann (1978) observed significant decreases in state anxiety of middle-aged men and women following 45 minutes of jogging. The author continued to track the anxiety levels of these subjects during the ensuing 24-hour period and noted that anxiety gradually increased and returned to baseline levels within 4 to 6 hours. Thus, the exercise bout was effective in reducing state anxiety but the consequences were short-lived. This finding led to the
suggestion that one of the major benefits of regular exercise may be its ability to reduce anxiety on a daily basis and thereby prevent the development of chronic anxiety (Morgan, 1981).

A recent study by Berger and Owen (1984) corroborated Seemann's results with a study on swimming and anxiety. The STAI (Spielberger, Gorsuch, & Lushene, 1970) was administered to students in a swimming class on the first day of swimming and before and after the third day of testing. The experimenters reported only short-term changes as a result of swimming for both state and trait anxiety and concurred with Morgan's earlier conclusion that the relaxing effects of exercise are only temporary in nature.

To summarize, the studies in this section suggest that vigorous exercise is effective in the enhancement of mental health. However, this effect appears to be a transient one and must be repeated on a regular basis for continued positive results.

Chronic Effects

This section of the paper will review chronic studies investigating the axiom "a sound mind in a sound body." A substantial body of evidence now exists which supports the belief that the psyche benefits along with the body as a result of regular vigorous physical activity (e.g., Folkins, Lynch, & Gardner, 1972; Ismail & Trachtman, 1973;
Kostubala, 1976; Lion, 1978). Although many of these studies are correlational in nature and some suffer from methodological flaws, they nevertheless represent consistent trends suggesting that, for most people, improvements in mental health are concomitant with improvements in physical health.

One way to investigate chronic effects is by examining (1) athletes versus non-athletes, and (2) personality changes over time. Morgan and Vogel (as cited in Morgan, 1976) offer evidence indicating that athletes possess more positive psychological profiles than non-athletes. In one study, a sample of 235 young soldiers were classified into two groups according to their athletic participation in high school. The results showed that the former athletes had less state and trait anxiety, more vigor, and a more favorable estimation of their physical self. Although the two groups did not differ significantly on measures of confusion, extroversion, anger, depression, or neuroticism, in no instance did the former athletes indicate less favorable emotional characteristics than the non-athletes.

Similar findings were reported by Johnson and Morgan (as cited in Morgan, 1976) in a study of 1300 freshman at the University of Wisconsin. The Minnesota Multiphasic Personality Inventory (MMPI) was administered to each student during the first week of college. The sample was comprised of entering athletes for the 1960-1964 classes.
and a group of 100 non-athletes selected at random from each of the five classes. Evaluation of the 1300 profiles revealed that athletes scored significantly more favorably on five of the MMPI scales as compared to the non-athletes.

Another critical question has been raised by sport scientists regarding the cause and effect relationship between psychological characteristics and the degree of involvement in athletics. That is, does participation in sport and/or regular physical activity lead to the development of positive mental qualities or do these qualities exist from the outset and thereby influence the gravitation toward sport?

Several early longitudinal studies lend insight into this issue and suggest that the latter may be the case (Lukehart & Morgan, 1969; Werner, 1960; Werner & Gottheil, 1966). Werner and Gottheil (1966) administered the Cattell 16 Personality Factor (16 PF) test to 340 freshmen entering West Point Military Academy who had competed in high school athletics and to a random selection of non-athletes. The two groups differed significantly on 7 of the 17 factors. The former athletes were more sociable, dominant, enthusiastic, adventuresome, tough-minded, group-dependent, and sophisticated than non-athletes. The students were tested a second time at graduation and found to differ again despite the fact that the former non-athletes had just completed 4 years of athletic participation at the Academy.
Yanada and Hirata (1970) confirmed the above findings in a cross-cultural study. The investigators reported that students who dropped out of their sport clubs at the University of Tokyo were initially more depressed, neurotic, and manic, than the athletes who continued in competition.

More recently, Morgan and Pollock (1977) conducted a comprehensive comparison of high-level wrestlers, rowers, and runners and found that all the athletes had similar psychological profiles as assessed by the POMS. Scores of the athletes fell below the mean reported for college students in depression, anxiety, fatigue, and confusion. Acknowledging that the below normal levels of such mood states in the athletes may be attributed to initial differences or to the exercise per se, the authors reasoned that the latter probably offered the most accurate explanation of the findings. Their decision was based on the fact that their athletes scored in the same range as the general college population on the relatively stable personality traits of extroversion and neuroticism, and therefore it was likely that their low mood state scores, i.e., unstable measures, were a consequence of the regular vigorous physical activity rather than pre-existing differences.

Thus, although it appears that athletes have a lesser tendency to suffer from moodiness than the general population, the correlational nature of research thus far does not allow a definitive statement of causality to be made.
Whether athletes and non-athletes differ initially on particular personality traits which thereby influence their chosen pursuits or whether the vigorous exercise of athletes enhances the development of desirable mental states and traits is an issue that demands further research.

The issue of psychological health in athletes versus non-athletes has been taken one step further to that of the clinically depressed versus non-depressed individuals or "normals." This section will briefly examine studies investigating the effects of exercise on the mood states of individuals diagnosed as being clinically depressed or anxious.

Lion (1978) studied the effect of running on anxiety by comparing three chronic psychiatric patients participating in a supervised running program with three non-running control subjects. All subjects were randomly assigned to their respective groups and received equal amounts of attention from the experimenter. Exercise consisted of 1 mile of running/walking three times per week. After 8 weeks, the State Trait Anxiety Inventory (STAI) revealed that the running group had significantly less trait anxiety than the control group. Although results of this study are limited by the small sample size, they are nevertheless supported by the majority of studies conducted with this population.
Greist, Klein, Eischens, and Faris (1978) investigated the effects of running in 24 depressed patients as diagnosed by National Institute of Mental Health (NIMH) criteria. The patients were randomly divided into three groups: (a) running, (b) time-limited psychotherapy, and (c) time-unlimited psychotherapy. The runners met individually with a running therapist three times per week for 45 minutes. The topic of depression was avoided during the run and discussion focused on running itself. The psychotherapy patients also met individually with a therapist with each session lasting 10 minutes to infinity for the time-limited and time-unlimited psychotherapy, respectively. After 10 weeks, the runners showed a significant decrease in depression scores, a result comparable to the best outcomes obtained by both psychotherapy groups.

Adding to the accumulating evidence that running is effective in reducing depression levels among the clinically depressed, Blue (1979) reported two case studies of former patients who were hospitalized due to their severe degree of depression. Following their release from the psychiatric unit, both subjects failed to respond to antidepressant medication, empathy, and cognitive-behavioral therapy in the next 10 weeks. Both patients were then encouraged to jog two or three times per week. Results showed that after 3 weeks of jogging, the patients reduced their scores on the Zung Depression Scale (Zung, 1965) by 15 and 18 points,
bringing them up to the "mildly" and "minimally" depressed categories, respectively.

Two additional studies also reported positive results with a combined program of running and counseling. Rueter and Harris (1980) randomly assigned moderately depressed individuals who sought psychological services to one of two treatment conditions: (a) counseling, or (b) counseling plus running. After 10 weeks, the counseling plus running condition produced significantly greater reductions in depression than the counseling alone condition as assessed by the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). Buffone (1980) noted almost identical changes in depression following an 8-week period of a similar running/counseling treatment program in severely depressed patients but failed to find a change in anxiety as measured by the MMPI.

Collective results of the above studies strongly suggest that running can be a valuable form of treatment for clinically depressed patients when used either alone or in combination with traditional modes of therapy. The question has been raised, however, regarding the benefit of running for those who are not clinically depressed. That is, does running benefit only those scoring below the normal range of depression or can it be used by the rest of the population to enhance their already healthy mental states?
To answer this question, several studies employing college students as subjects will be reviewed below.

Sharp and Reilley (1975) conducted a study to examine the relationship between physical fitness and depression. Sixty-five male college students participated in aerobic exercise and/or running for 45 minutes twice a week. At the end of each semester, fitness levels were assessed by measuring oxygen uptake and performance on a 12-minute run test. The authors reported that improved physical fitness was associated with lowered depression scores on the MMPI. Hilyer and Mitchell (1979) obtained similar results with self-concept. Forty college students were randomly assigned to one of three treatment conditions: (a) fitness training, which includes flexibility exercises and systematic distance running; (b) fitness training plus 1 hour per week of group counseling; or (c) no treatment control. After 10 weeks, both fitness groups showed significant gains in self-concept as measured by the Tennessee Self-Concept Scale compared to the non-treatment control group. However, individuals already high in self-concept did not improve whereas those low in self-concept did.

Folkins, Lynch, and Gardner (1972) added support to the above studies with their investigation of the effects of a semester-long running program on selected physiological and psychological variables. An exercise group comprised of 44 joggers in a jogging class was compared to a control
group of students in archery and golf classes. Pre- to post-test changes in heart rate and performance on a 1.75 mile running test indicated significant improvements in physical fitness as well as in measures of personal adjustment, anxiety, self-confidence, depression, sleep restfulness, and work efficiency. These changes were most pronounced in subjects whose physical and psychological condition was poorest from the outset. That is, those students who had the most to gain from the experimental exercise did indeed show the greatest physiological and psychological improvements.

A recent study by Jasnoski and Holmes (1981) corroborates the earlier studies cited above. Findings of this investigation showed that among 103 college women participating in aerobics classes, women who were initially higher in aerobic capacity were significantly less depressed than their less fit counterparts. Furthermore, women who were most fit did not reduce their initial levels of depression.

Conclusions drawn from these studies as well as others dealing with adult non-students (e.g., Buccola & Stone, 1975; Ismail & Trachtman, 1973; Morgan, Roberts, Brand, & Feinerman, 1970) suggest that physical fitness is positively correlated with mental fitness. Further, unfit individuals begin to approach fit normals in certain psychological characteristics as a result of progressive exercise. In response to the question posed earlier regarding the
psychological benefit of exercise to those individuals already scoring in the normal range of mental health, the evidence indicates that any gains above their initial level are insignificant. It should be noted, however, that statistical significance may not be equal to personal significance; that is, statistical significance is limited by the sophistication and precision of psychological testing devices. Improvements regarded as small and insignificant may indeed be personally significant to the subjects involved in the study. This notion was supported in the study by Morgan et al. (1970), whose subjects reported "feeling better" following 6 weeks of chronic exercise despite a lack of statistical significance.

As noted by the above studies, the majority of investigators examining the mood-enhancing effect of exercise have employed activities of an aerobic nature (e.g., Buffone, 1980; Greist et al., 1978; Jasnoski & Holmes, 1981). Indeed, Folkins et al. (1972) demonstrated that aerobic as opposed to anaerobic is necessary to produce positive affect when control subjects participating in archery and golf did not show significant psychological gains when compared to runners. This idea makes sense intuitively when it is considered that physiological fitness is attained only through chronic vigorous physical activity of a sufficient intensity (Astrand & Rodahl, 1977) and that
physiological and psychological health are highly correlated.

Strong support for this notion is provided by a two-part study by Brown, Ramirez, and Taub (1978). The study includes both depressed and non-depressed students and psychological variables associated with a 10-week exercise program. In part I, 167 non-depressed men and women selected a physical activity in which they participated for 30 minutes per day 3 days per week: jogging, tennis, wrestling, softball, or a varied exercise program. A significant reduction in depression was observed in all subjects except the softball players and six no-exercise control subjects.

In part II, depressed subjects were separated from non-depressed subjects and included a total of 561 college students: depressed subjects who jogged, depressed subjects who served as non-jogging controls, non-depressed subjects who jogged, and non-depressed subjects who served as non-exercising controls. Each subject chose whether to jog 3 days per week, 5 days per week, or not at all. The two jogging groups gradually increased their exercise to a minimum of 30 minutes per session. Although both the depressed and non-depressed groups of joggers significantly reduced their levels of depression, the reductions were of a much larger magnitude for the depressed population. The authors attributed the reductions in depression to jogging
because no changes were observed for the depressed and non-depressed groups who did not jog. Based on this two-part study, Brown et al. concluded that the anti-depressant effect of exercise seemed to depend on the frequency, intensity, and duration of exercise. Softball players who were not involved in aerobic exercise were similar to non-exercising controls in showing no change in depression; tennis players had small but significant decreases in depression; and joggers who ran 5 days per week demonstrated the largest decreases.

The above study by Brown et al. cogently argues that the aerobic component of exercise is vital for chronic anti-depressant effects. Although there is support for this idea among sport scientists (e.g., Berger, 1984a; Folkins, Lynch, & Gardner, 1972), the evidence is not unequivocal. Berger (1984b) and Pistacchio (1984) failed to find chronic mood-enhancing effects after 5 weeks of swimming, running, and aerobic dance.

Pistacchio (1984) used a chronic version of POMS to assess anxiety, depression, and hostility among 70 college females before and after a 5-week exercise program of both running and aerobic dance. Neither form of aerobic exercise produced a significant chronic reduction in the three psychological variables assessed. Berger (1984b) corroborated the above findings with a study involving the aerobic activity of swimming. After 5 weeks, the STAI revealed
no significant changes in trait anxiety from pre- to post-program.

Thus, conclusions regarding the psychological benefits of exercise must be qualified by several factors including initial physical and psychological condition of the individual, type of exercise, intensity of the exercise, and duration of mood-enhancement. In general, the research suggests that exercise does indeed improve the quality of one's mental states (i.e., acute changes) but improvements in mental traits (i.e., chronic changes) are more tenuous and require further refinements in assessment instruments and procedures to warrant definitive conclusions.

Mechanisms Underlying Post-exercise Mood-elevation

The preceding pages have documented the evidence regarding post-exercise mood-enhancement. While the existing data does favor the existence of positive affect following exercise, the exact mechanisms responsible for this sensation are poorly understood. Several theories of both a physiological and psychological nature have been offered to account for this post-exercise phenomenon. This section will briefly review explanations cited in the current literature pertaining to both acute and chronic mood changes.
Acute Mechanisms: Physiological Theories

1. Endorphins. Many investigators (e.g., Appenzeller, Standefer, Appenzeller, & Atkinson, 1980; Pargman & Baker, 1980, Ransford, 1982; Riggs, 1981) have reported that exercise induces the release of enkephalin which promotes a feeling of euphoria. From this work it was suggested that exercise-induced biochemicals are responsible for the feeling of well-being following a workout. Enkephalin is a subunit of the class of endogenous peptides known as endorphins which affect the body in a manner resembling morphine (Ransford, 1982; Riggs, 1981). This theory has been challenged, however, by a study failing to reverse the level of endorphins in the blood with Naloxone, a narcotic antagonist (Markoff, Ryan, & Young, 1982).

2. Amines. Amines are chemicals in the brain secreted by neurons into the synapse which thereby transmit information to neighboring neurons. Varying intensities of aminergic synaptic transmission, possibly caused by exercise, can dramatically influence the function of the nervous system. Since amines are targeted for brain centers thought to be associated with sensations of pleasure (Carlson, 1974), exercise is considered to create an antidepressant effect by alteration of amine activity. Although much of this research has been conducted with animals (e.g., Ellison, 1977), this hypothesis can only be tested indirectly with humans by excretion of metabolites and thus far has received
equivocal results (e.g., Hollister, Davis, Overall, & Anderson, 1978; Post, Kotin, Goodwin, & Gordon, 1973).

**Acute Mechanisms: Psychological Theories**

1. **Diversion.** The distraction or "time out" from daily stresses that exercise provides has been offered as explanation to account for the positive affect that follows exercise (Barke & Morgan, 1978). This idea has received some support (Byrd, 1964; Wilson, Berger, & Bird, 1981), but experiments testing various intensities of exercise report that only strenuous activity results in positive affect (Morgan, 1973, 1976; Morgan et al, 1971) thereby challenging the diversion theory.

2. **Social interaction.** Social interaction which often accompanies two or more people exercising together has been suggested as the key component underlying the influence of exercise on mood. Although intuitively appealing, some studies have shown that lone joggers report significantly lower negative affect following their run than those maintaining social contact while playing softball (Brown et al., 1978), golf, or archery (Folkins et al., 1972).

3. **Mastery.** As frequently occurs after conquering a difficult task, a sense of accomplishment or mastery prevails with associated feelings of pride. If strenuous exercise is perceived as a difficult task requiring much effort and perseverance, the completion of such could
conceivably lead to feelings of self-satisfaction. This theory has become popular in the current literature, however, studies have yet to be conducted to test this idea directly.

4. Expectancies. Fitness fanatics and popular magazine journalists touting post-exercise euphoria are ubiquitous. As such, it is difficult to distinguish the actual mood-enhancement following exercise that a subject reports from that expectation of exercise. The few studies that have tested this idea directly indicate that the expectation of psychological benefits from exercise does indeed influence an individual's report of such (Harnes, 1979; Riddle, 1980). Expectancies have been shown to be extremely powerful mediators in related sport psychology areas and thus deserve more experimental attention regarding the post-exercise sensations.

Chronic Mechanisms: Physiological Theories

1. Depression-associated substances. Some researchers have suggested that several endogenous substances commonly associated with emotional disorders are modified with chronic exercise. Such substances include cholesterol, glucose, androgens, and corticosteroids (Ismail & Young, 1977). Elevated cholesterol levels have been identified particularly with feelings of depression, fear, competitiveness, and aggression (Ransford, 1982).
2. Stress adaptation. One of the most popular explanations of mental health enhancement due to exercise is that chronic exercise may improve the body's adaptation to stress by increasing the efficiency of the adrenal glands and the entire autonomic nervous system. Regular aerobic exercise, with its demands for sympathetic nervous system and related endocrine activity, leads to chronic reduction in the individual's response to psychological stressors (Dienstbier, Crabbe, Johnson, Thorland, Jorgensen, Sadar, & LaVelle, 1981; Edington & Edgerton, 1976). Most of this research is based on Selye's (1976) well-documented General Adaptation Syndrome.

**Chronic Mechanisms: Psychological Theories**

1. Perception of physical change. The only psychological theory that has been advanced to account for chronic improvements in mood due to exercise involves the participant's change of body image from pre- to post-program. Since chronic exercise usually brings a healthier, more physically fit and appealing body, and these qualities are valued by most people in our society, then it logically follows that a more positive body image will develop. Further, this improved body image largely contributes to a generally positive self-concept which is highly correlated with general psychological health (Berger, 1984a; Dienstbier, 1984). Heaps (1978) has reported some experimental data to
support this hypothesis in one of the few studies conducted in this area.

Research investigating the variables mediating the exercise-mental health relationship is clearly in its infancy. The various psychological and physiological theories advanced to explain both acute and chronic improvements in mood following exercise have received limited experimental attention. Most sport scientists agree, however, that the mechanisms underlying such changes are probably multifarious and will therefore require sophisticated assessment instruments of a psychological, physiological, and biochemical nature.

**Psychobiologic Concept**

Evidence supporting the tranquilizing and antidepressant effects of exercise appears encouraging but methodological shortcomings make it impossible to draw definitive conclusions regarding causality at this time. Nevertheless, interest in this area has continued both in research and in professional health care. Indeed, the past two decades have witnessed a resurgence in behavioral medicine and health care from a psychobiologic or "mind-body" perspective. It is now recognized that the complex functions of the human system are highly interdependent. This concept is convincingly demonstrated by such psychosomatic disorders as migraine headaches, peptic ulcers, essential hypertension,
and certain cases of arthritis and sexual impotence (Brown, 1974; Buffone, 1984; Pelletier, 1977).

The psychological consequences of exercise, however, are perhaps the most salient demonstrations of the psychobiologic process. Yet despite the positive claims by exercise participants, statistics reveal that 50% of all people who begin an exercise routine discontinue it within the first 6 months (Dishman, 1984a, 1984b; Morgan, 1977). This is a most unfortunate trend since the physical and psychological benefits of exercise cannot be accrued if exercise is not continued on a regular basis.

Why do people drop out? Reasons expressed for recidivism include (1) conflicting responsibilities (e.g., an individual would like to exercise after work but must be home to attend to family needs, (2) lack of free time (e.g., other interests such as reading the newspaper or simply relaxing compete with exercise for the limited time available), (3) lack of social support (e.g., spouse or significant others do not encourage regular exercise), and (4) inconvenience of exercise setting. Such negative aspects of participation possibly outweigh the positive aspects for many people. Which individuals are most likely to adhere to or drop out of an exercise program? The following studies acknowledge this question and offer some possible answers.
Dishman (1984a; 1984b) and his colleagues (Dishman & Gettman, 1980; Dishman, Ickes, & Morgan, 1980) have conducted substantial research in the psychobiologic area to identify exercise adherers and dropouts. A complex conceptual framework was developed consisting of numerous variables of a psychological, biological, and situational origin. Psychological variables included attitude toward exercise, self-motivation, and personality traits; biological variables included fitness level, body composition, and history of coronary heart disease; and situational variables included convenience of the exercise setting, support from significant others, and exercise intensity. A prediction model including all the variables was developed to assess the relative contribution of each variable and their interaction in predicting exercise adherence. The findings indicated that only self-motivation, percent body fat and body weight discriminated between eventual adherers and dropouts. Post hoc analyses also indicated that the combination of these three variables accurately classified adherers and dropouts in 80% of all cases and accounted for 50% of the variance in adherence behavior.

Results of the Dishman et al. studies underscore the importance of both psychological (e.g., self-motivation) and biological (e.g., percent body fat and body weight) dimensions in exercise behavior. The fact that situational variables did not emerge as significant predictors of
exercise adherence was contrary to the authors' theoretical expectations. It was suggested that perhaps the psychological factor of self-motivation may be more potent than the situational factor of exercise setting accessibility; i.e., a highly self-motivated individual will adhere to exercise despite inconveniences.

A subsequent study (Ward & Morgan, 1984) evaluated the effectiveness of the psychobiological prediction equation proposed by Dishman and Gettman (1980) which included self-motivation, percent body fat, and body weight. In addition, age, height, blood pressure, and all six scales of the POMS inventory (e.g., tension, depression, anger, vigor, fatigue, and confusion) were included as well as three measures of physical fitness (e.g., 15-minute run, sit-ups, and flexibility). Adherence data was analyzed by attendance records on three separate occasions during the exercise program (i.e., at week 10, 20, and 32) in an attempt to elucidate possible differences between "early" and "late" dropouts. Data from the current study were analyzed in a variety of ways and thus yielded numerous and highly complex results. Therefore, only findings relevant to the ensuing paper will be reported.

First, the variables included in the equation produced a prediction accuracy of 83% and 91% for male and female adherents, respectively. The prediction of dropouts was quite different, however, with an accuracy of only 25% for
each of the samples. Although the dropout rates for both males and females were nearly identical, the variables discriminating adherents from dropouts was different in each sex. Male adherents scored more positively on the POMS assessment and were 10 years older than their dropout counterparts. Female adherents were less angry and less flexible than female dropouts. Secondly, neither male or female adherents and dropouts differed on self-motivation, percent body fat or body weight at any point in time as predicted by the Dishman-Gettman equation. Finally, other correlates of adherence (e.g., tension, age, vigor, blood pressure, anger, 15-minute run and sit-up performance) were found to differ among the 10-, 20-, and 32-week analyses and between males and females.

In summary, the two studies reviewed above using the psychobiologic approach are similarly effective in predicting exercise adherence but differ greatly in the prediction of recidivism. Also, completely different factors were associated with adherence in males and females, suggesting that it may be more advantageous to use different strategies in an effort to improve adherence for both sexes (Ward & Morgan, 1984).

The identification of factors underlying exercise recidivism is of the utmost importance if effective strategies are to be developed to reverse such a trend. Since claims of post-exercise mood elevation can be
expressed only by individuals who exercise, then perhaps the individuals who drop out of exercise are those who do not experience the tranquilizing and antidepressant effects. That is, individuals who drop out possibly do so because they do not experience—and therefore are not motivated by—the same mood-enhancing effects as do others. If this proposition is accepted, then a technique to more accurately identify potential adherents and dropouts may reside in the identification of individuals who do and those who do not experience post-exercise positive affect. By this assessment, potential dropouts can be identified early in the program and strategies can be targeted for such individuals in an attempt to increase psychological well-being and, hence, prevent recidivism. Thus, the purpose of the present study is to develop a psychobiologic profile of individuals who experience and those who do not experience the tranquilizing and antidepressant effects of exercise.


CHAPTER III

METHOD

Subjects

The original sample consisted of male and female students (N = 301) presently enrolled in physical education classes of an aerobic nature (e.g., conditioning, aerobic dancing, jogging) at North Texas State University. For statistical comparisons, subjects were divided into several sub-groupings, and thus each group was made up of a portion of the total sample (specific sub-sample sizes are stated in Chapter V). The first sub-grouping consisted of subjects who scored one standard deviation above the mean change score (i.e., those who experienced exercise-related mood-enhancement) and subjects who scored one standard deviation below the mean change score (i.e., those who did not experience exercise-related mood-enhancement). These two sub-groups were compared on the four criterion variables of state anxiety, trait anxiety, state depression and trait depression.

A further sub-division consisted of only those subjects who were classified as initially high trait anxious or depressed (i.e., those subjects scoring one standard deviation above the mean). Again, comparisons will be performed on
the four criterion variables using only initially high trait anxious and depressed subjects.

**Procedures**

Based on research by Dishman (1984a; 1984b) and his colleagues (Dishman & Gettman, 1980; Dishman, Ickes, & Morgan, 1980) and Ward and Morgan (1984), selected variables were included in the psychobiologic prediction equation for identifying those individuals who experience post-exercise positive-affect and those who do not. Following are variables and a brief rationale for inclusion in the prediction equation as well as the assessment instruments employed.

**Psychological Variables**

1. Mental states and traits including tension and depression. These psychological variables were included in an attempt to determine if an individual's mood or temperament influences his/her post-exercise affect. The acute and chronic versions of the Profile of Mood States (POMS) (McNair, Lorr, & Droppleman, 1971) were used to assess state and trait anxiety and depression. (See Appendix A & B). The authors state that reliability and validity are unchanged regardless of time set (i.e., acute or chronic). Test-retest reliability coefficients range from .61 to .74 for depression and from .61 to .70 for anxiety (McNair & Lorr, 1964). Concurrent validity coefficients of the depression
and anxiety scales range from .83 to .86 and from .74 to .77, respectively (McNair, Lorr, & Droppleman, 1971). The trait scale of the STAI (Spielberger et al., 1970) was also used to assess trait anxiety. (See Appendix C.) Test-retest reliability coefficients for this instrument range from .73 to .86 and similarly high concurrent validity coefficients of .72 to .85.

2. Attitude toward physical activity. Attitudes were included to determine whether an individual's motivation toward physical activity influences his/her psychological state following exercise. Attitudes regarding the relationship of physical activity to health and fitness were assessed by Kenyon's (1968) Attitude Toward Physical Activity (ATPA) scale. (See Appendix D.) The Health and Fitness scale as a measurement tool has reported test-retest stability coefficients ranging from .66 to .83 and criterion-related validity exceeding the .001 level of significance when employing the Known Groups Method for calculating differences between strong and weak preference groups (Kenyon, 1968).

3. Physical estimation and attraction. Self-perceptions of physical activity and interest in physical activity were assessed to determine the extent of which self-estimations mediate the exercise-"feel good" relationship. Sonstroem's (1978) Physical Estimation and Attraction Scale (PEAS) was employed to assess these variables. (See Appendix E.) Construct validity coefficients of .51 and
.87 have been reported for the estimation and attraction scales, respectively. Stability reliability coefficients of .92 and .94, respectively, have also been obtained (Sonstroem, 1976).

4. Expectancies of health benefits as a result of exercise. It is believed that the expectancy of favorable health outcomes may influence exercise behavior. The internal scale of the Multidimensional Health Locus of Control (MHLC) scale (Wallston, Wallston, & DeVellis, 1978) measures the degree to which an individual feels he/she is in control of his/her own health and was used in the present study. (See Appendix F.) A construct validity coefficient of .57 was obtained when correlated with Levenson's (1973) Internal scale and an alpha reliability coefficient of .77 (Wallston et al., 1978).

5. Self-motivation. An individual's motivation to exercise has been shown to predict adherence to an exercise program. The Self-Motivation Inventory (SMI) (Dishman, Ickes, & Morgan, 1980) has a reported discriminant validity coefficient of .63 with the Thomas-Zander (1973) Ego-Strength Scale and a reliability coefficient of .91 (Dishman et al., 1980). This scale was employed to assess self-motivation. (See Appendix G.)
Physiological Variables

1. Aerobic fitness. There is evidence to suggest that an individual's initial level of fitness is correlated with adherence to exercise (Dishman, Ickes, & Morgan, 1980). As such, this variable may predict the degree of positive affect experienced following exertion. Performance as measured by time on a 1.5 mile run was used to assess aerobic fitness. This field assessment of aerobic capacity is used interchangeably with the 12-minute run test and has well-documented validity and reliability (e.g., Cooper, 1977; Heaps, 1978; Sharp & Reilley, 1975).

2. Body fat percent. Dishman et al. (1980) found that an individual's body fat percentage contributed to an accurate prediction of exercise adherence. It is therefore believed that degree of body fat may also influence the sensation of positive affect following exercise. The assessment of body fat with skinfold calipers by a trained technician is both a reliable (.99) and valid (.88) technique (Vlasek & Hartung, 1980) and was employed in the present investigation.

Exercise Schedule

Physical activity consisted of running or aerobic dance performed 3 times/week for a duration of 20-30 minutes at a minimum intensity of 60% maximal capacity. Intensity was confirmed by subjects monitoring their own pulse rate. Exercise continued for 10 weeks.
Data Collection

**Discriminating Variables: Assessed During Week 1**

Instruments assessing such psychological variables as trait anxiety and depression (POMS), self-motivation, self-perception of physical ability and attraction to physical activity, expectations of health benefits through exercise and perceived values of physical activity were administered as well as the two biological variables of aerobic fitness and percent body fat. A gender variable (i.e., male or female) was also employed. These variables were used to form the psychobiologic profile.

**State Variables: Assessed During Weeks 4 and 8**

State anxiety and depression were assessed by POMS (McNair, Lorr, & Droppleman, 1971) pre- and post-exercise to measure the acute effects of exercise. Subjects were instructed to complete post-exercise questionnaires immediately following a 5-minute cool-down phase after aerobic activity. Subjects whose score changed from pre- to post-exercise fell at least one standard deviation above or below the mean change score made up the groups consisting of those who experienced and those who did not experience post-exercise mood-elevation, respectively.
Trait Variables: Assessed During Weeks 1 and 10

Trait anxiety and depression were assessed by the STAI (Spielberger et al., 1970) and the Trait Version of the POMS depression scale (McNair, Lorr, & Dropileman, 1971), respectively. As with the state measures, subjects whose score changes from week 1 to week 10 fell at least one standard deviation above or below the mean change score formed the groups consisting of those who experienced and those who did not experience chronic exercise-related mood-enhancement, respectively.


CHAPTER IV

RESULTS

Data Analysis

Since the purpose of the present investigation was to develop a psychobiologic profile of individuals who experienced or did not experience exercise-related mood-enhancement, multivariate analysis of variance and discriminant function analysis were employed to determine which variable maximally discriminated between these two groups of individuals. The variable assessments provided four separate psychobiologic profiles: (1) trait anxiety, (2) trait depression, (3) state anxiety, and (4) state depression.

The first analysis conducted was an overall regression of all subjects (N=301) in the study. This procedure was followed by a discriminant function analysis to determine which variables best separated individuals who experienced post-exercise mood-elevation from those who did not. Lastly, individuals who were initially high in trait anxiety were analyzed to determine which variables best discriminated between those who showed a post-exercise improvement in anxiety and those who showed no change. A separate but identical analysis was conducted on individuals who initially scored high in trait depression.
Preliminary Analysis

The correlation matrix displayed in Table I was computed to determine if in fact the predictor variables, particularly the psychological variables, are measuring different but possibly related constructs. The predominance of low to moderate correlations show that this indeed appears to be the case. The higher correlations generally occurred between the different fitness-related variables (e.g., body fat percent, run performance, gender) and was not unexpected. Moderately high positive correlations were also found between physical estimation and physical attraction and between trait anxiety and depression.

Correlations between the first and second administrations of the state anxiety and depression inventories (pre- and post-exercise) are shown in Table II. The two inventories were administered four weeks apart under similar circumstances. Such state measures should generally have only a moderate correlation since moods normally fluctuate in response to the immediate situation. On the other hand, however, individuals also maintain a certain consistency in behavior. The moderately low correlations produced in the present study confirm this rationale. For the same reason, it was expected that state anxiety and depression correlated highly on the same trial days. Finally, group means and standard deviations for each variable fell within normal limits and are provided in Table III.
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### TABLE II

**PEARSON CORRELATION COEFFICIENTS BETWEEN STATE ANXIETY AND DEPRESSION (PRE- AND POST-EXERCISE) FOR TRIALS 1 and 2**

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</tr>
<tr>
<td><strong>Anx 1-Post</strong></td>
<td>.4435</td>
<td>1.0000</td>
<td>.4433</td>
<td>.7383</td>
<td>.3453</td>
<td>.5410</td>
<td>.3204</td>
<td>.4049</td>
</tr>
<tr>
<td><strong>Dep 1-Pre</strong></td>
<td>.6255</td>
<td>.4433</td>
<td>1.0000</td>
<td>.6078</td>
<td>.2492</td>
<td>.1366</td>
<td>.3392</td>
<td>.2589</td>
</tr>
<tr>
<td><strong>Dep 1-Post</strong></td>
<td>.3613</td>
<td>.7383</td>
<td>.6078</td>
<td>1.0000</td>
<td>.2548</td>
<td>.3682</td>
<td>.3943</td>
<td>.4638</td>
</tr>
<tr>
<td><strong>Anx 2-Pre</strong></td>
<td>.3093</td>
<td>.3453</td>
<td>.2492</td>
<td>.2548</td>
<td>1.0000</td>
<td>.5869</td>
<td>.6492</td>
<td>.4744</td>
</tr>
<tr>
<td><strong>Anx 2-Post</strong></td>
<td>.1346</td>
<td>.5410</td>
<td>.1366</td>
<td>.3682</td>
<td>.5869</td>
<td>1.0000</td>
<td>.4596</td>
<td>.5636</td>
</tr>
<tr>
<td><strong>Dep 2-Pre</strong></td>
<td>.1655</td>
<td>.3204</td>
<td>.3392</td>
<td>.3943</td>
<td>.6492</td>
<td>.4596</td>
<td>1.0000</td>
<td>.8003</td>
</tr>
<tr>
<td><strong>Dep 2-Post</strong></td>
<td>.1445</td>
<td>.4049</td>
<td>.2589</td>
<td>.4638</td>
<td>.4744</td>
<td>.5636</td>
<td>.8003</td>
<td>1.0000</td>
</tr>
</tbody>
</table>
**TABLE III**

MEANS AND STANDARD DEVIATIONS FOR PSYCHOLOGICAL AND BIOLOGICAL PREDICTOR VARIABLES AND DEPENDENT VARIABLES (N=301)

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Body Fat (%)</td>
<td>20.189</td>
<td>8.184</td>
</tr>
<tr>
<td>*1.5 Mile Run (seconds)</td>
<td>881.266</td>
<td>217.465</td>
</tr>
<tr>
<td>*Trait Anxiety (POMS)</td>
<td>11.890</td>
<td>6.005</td>
</tr>
<tr>
<td>*Multi. Health Locus of Control</td>
<td>27.432</td>
<td>4.250</td>
</tr>
<tr>
<td>*Activity for Health &amp; Fitness</td>
<td>46.601</td>
<td>6.755</td>
</tr>
<tr>
<td>*Self-motivation</td>
<td>144.987</td>
<td>20.113</td>
</tr>
<tr>
<td>*Estimation of Physical Ability</td>
<td>20.392</td>
<td>7.479</td>
</tr>
<tr>
<td>*Attraction to Physical Activity</td>
<td>34.774</td>
<td>8.928</td>
</tr>
<tr>
<td>+*Trait Depression (POMS) (pre)</td>
<td>12.392</td>
<td>10.559</td>
</tr>
<tr>
<td>+*Trait Anxiety (STAI) (pre)</td>
<td>37.983</td>
<td>7.821</td>
</tr>
<tr>
<td>#State Anxiety - 1 (pre)</td>
<td>8.000</td>
<td>6.157</td>
</tr>
<tr>
<td>#State Anxiety - 1 (post)</td>
<td>5.861</td>
<td>5.051</td>
</tr>
<tr>
<td>#State Depression - 1 (pre)</td>
<td>6.402</td>
<td>8.009</td>
</tr>
<tr>
<td>#State Depression - 1 (post)</td>
<td>3.649</td>
<td>6.735</td>
</tr>
<tr>
<td>#State Anxiety - 2 (pre)</td>
<td>7.056</td>
<td>5.686</td>
</tr>
<tr>
<td>#State Anxiety - 2 (post)</td>
<td>5.151</td>
<td>4.943</td>
</tr>
<tr>
<td>#State Depression - 2 (pre)</td>
<td>5.901</td>
<td>8.142</td>
</tr>
<tr>
<td>#State Depression - 2 (post)</td>
<td>3.108</td>
<td>6.667</td>
</tr>
<tr>
<td>+*Trait Depression (POMS) (post)</td>
<td>8.144</td>
<td>7.412</td>
</tr>
<tr>
<td>+*Trait Anxiety (STAI) (post)</td>
<td>38.342</td>
<td>8.402</td>
</tr>
</tbody>
</table>

*Predictor variables
+Change measures (Trait)
#Change measures (State)
Multiple Regression Analysis

To determine the relationship between exercise-related mental states/traits and the variables employed, a stepwise multiple regression analysis was conducted. Of the four change measures (i.e., state anxiety, trait anxiety, state depression, and trait depression), only trait depression yielded information accounting for a significant portion of the variance. Specifically, 54.95% of the variance change in trait depression over the 10-week exercise period was accounted for by the variance in pre-existing trait depression prior to the 10-week period. Trait anxiety, self-motivation, and attitude regarding physical activity for purposes of health and fitness enhanced the prediction equation to 58.65% of shared variance.

For state depression, the only significant predictor variables entered into the equation were sex and pre-existing trait depression. The combination of these two variables accounted for only 7.66% of the variance.

Predictor variables for state anxiety also produced limited value for prediction with the linear combination of sex, attitude toward physical activity for purposes of health and fitness, and trait anxiety accounting for only 9.86% of the variance.

Lastly, the only predictor variable entered into the equation for trait anxiety was estimation of physical ability which accounted for a meager 2.27% of the variance. These regression results are summarized in Table IV and a
correlation matrix of all predictor and criterion variables is displayed in Table V. The combined information on Tables IV and V corroborate the fact that there was generally little relation between predictor and criterion variables.

Discriminant Function Analysis: Post-exercise Improvement Versus No Change

The correlations between pre- to post-exercise change scores for state anxiety and depression on trial 1 and trial 2 were fairly weak indicating that exercise resulted in somewhat different mood changes from trial 1 to trial 2. This was not totally unexpected since state measures are by definition unstable and vary over time. However, the correlations also show that state anxiety and depression are moderately related in that they increase or decrease together after each exercise bout. It should be noted that 64 subjects (21.6%) did not have a second pre-post state assessment and thus only the first assessment was employed in the subsequent analysis. These correlations are displayed in Table VI. Means and standard deviations of pre- to post-exercise differences in state and trait anxiety and depression are provided in Table VII.

Subjects whose change score from pre- to post-exercise on trait or state anxiety or depression fell one standard deviation above or below the mean change score defined the groups that (1) experienced post-exercise mood-elevation,
<table>
<thead>
<tr>
<th>Criterion Variable</th>
<th>Step No.</th>
<th>Predictor Variable</th>
<th>Multiple R</th>
<th>R Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Depression</td>
<td>1</td>
<td>Trait Depression</td>
<td>.74129</td>
<td>.54951</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Trait Anxiety</td>
<td>.75374</td>
<td>.56813</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Self-motivation</td>
<td>.76144</td>
<td>.57979</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Activity for Fitness</td>
<td>.76586</td>
<td>.58654</td>
</tr>
<tr>
<td>State Depression</td>
<td>1</td>
<td>Sex</td>
<td>.24160</td>
<td>.05837</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Trait Depression</td>
<td>.27676</td>
<td>.07660</td>
</tr>
<tr>
<td>State Anxiety</td>
<td>1</td>
<td>Sex</td>
<td>.20637</td>
<td>.04259</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Activity for Fitness</td>
<td>.26845</td>
<td>.07207</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Trait Anxiety</td>
<td>.31408</td>
<td>.09865</td>
</tr>
<tr>
<td>Trait Anxiety</td>
<td>1</td>
<td>Estimation</td>
<td>.15091</td>
<td>.02277</td>
</tr>
</tbody>
</table>
TABLE V
PEARSON CORRELATION COEFFICIENTS BETWEEN PREDICTOR VARIABLES AND DIFFERENCES IN STATE AND TRAIT ANXIETY AND DEPRESSION FROM PRE- TO POST-EXERCISE

<table>
<thead>
<tr>
<th></th>
<th>DAT</th>
<th>DAS</th>
<th>DDT</th>
<th>DDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>.0023</td>
<td>-.2064</td>
<td>-.1060</td>
<td>-.2416</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>.0619</td>
<td>.0687</td>
<td>.0861</td>
<td>.1217</td>
</tr>
<tr>
<td>1.5 Mile Run (seconds)</td>
<td>.0835</td>
<td>.0906</td>
<td>.1099</td>
<td>.1786</td>
</tr>
<tr>
<td>Health Locus of Control</td>
<td>-.0216</td>
<td>.0323</td>
<td>.0619</td>
<td>-.0452</td>
</tr>
<tr>
<td>Activity for Health &amp; Fitness</td>
<td>.0262</td>
<td>.2021</td>
<td>-.0090</td>
<td>.1014</td>
</tr>
<tr>
<td>Trait Anxiety (POMS)</td>
<td>.1428</td>
<td>.1523</td>
<td>.3098</td>
<td>.1162</td>
</tr>
<tr>
<td>Trait Depression (POMS)</td>
<td>-.0043</td>
<td>.0013</td>
<td>.7413</td>
<td>.1559</td>
</tr>
<tr>
<td>Self-motivation</td>
<td>-.0648</td>
<td>.0723</td>
<td>-.0928</td>
<td>-.0324</td>
</tr>
<tr>
<td>Estimation</td>
<td>-.1509</td>
<td>.0253</td>
<td>-.0928</td>
<td>-.0385</td>
</tr>
<tr>
<td>Attraction</td>
<td>-.1013</td>
<td>-.0011</td>
<td>-.0132</td>
<td>-.0173</td>
</tr>
</tbody>
</table>
TABLE VI
PEARSON CORRELATION COEFFICIENTS BETWEEN PRE- TO POST- EXERCISE DIFFERENCES IN STATE ANXIETY (DSA) AND DEPRESSION (DSD) FOR TRIAL 1 AND TRIAL 2

<table>
<thead>
<tr>
<th></th>
<th>DSA1</th>
<th>DSD1</th>
<th>DSA2</th>
<th>DSD2</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSA1</td>
<td>1.0000</td>
<td>.5809</td>
<td>.3600</td>
<td>.0991</td>
</tr>
<tr>
<td>DSD1</td>
<td>.5809</td>
<td>1.0000</td>
<td>.2798</td>
<td>.2562</td>
</tr>
<tr>
<td>DSA2</td>
<td>.3600</td>
<td>.2798</td>
<td>1.0000</td>
<td>.5102</td>
</tr>
<tr>
<td>DSD2</td>
<td>.0991</td>
<td>.2562</td>
<td>.5102</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

TABLE VII
MEANS AND STANDARD DEVIATIONS OF PRE- TO POST- EXERCISE DIFFERENCES IN STATE AND TRAIT ANXIETY AND DEPRESSION

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference in Trait Anxiety</td>
<td>-.2662</td>
<td>6.3457</td>
</tr>
<tr>
<td>Difference in Trait Depression</td>
<td>4.2518</td>
<td>9.4941</td>
</tr>
<tr>
<td>Difference in State Anxiety Trial 1</td>
<td>2.1385</td>
<td>5.9862</td>
</tr>
<tr>
<td>Difference in State Depression Trial 1</td>
<td>2.7534</td>
<td>6.6279</td>
</tr>
<tr>
<td>Difference in State Anxiety Trial 2</td>
<td>1.9052</td>
<td>4.8759</td>
</tr>
<tr>
<td>Difference in State Depression Trial 2</td>
<td>2.7931</td>
<td>4.8840</td>
</tr>
</tbody>
</table>
or (2) did not experience post-exercise mood-elevation. The following are the eight possible groups into which subjects fell.

Trait Anxiety--Improve: subjects whose trait anxiety change score from pre- to post-exercise over the 10-week period fell one standard deviation above the mean change score.

Trait Anxiety--No change: subjects whose trait anxiety change score from pre- to post-exercise over the 10-week period fell one standard deviation below the mean change score.

State Anxiety--Improve: subjects whose state anxiety change score from pre- to post-exercise fell one standard deviation above the mean change score.

State Anxiety--No change: subjects whose state anxiety change score from pre- to post-exercise fell one standard deviation below the mean change score.

Trait Depression--Improve: subjects whose trait depression change score from pre- to post-exercise over the 10-week period fell one standard deviation above the mean change score.

Trait Depression--No change: subjects whose trait depression change score from pre- to post-exercise over the 10-week period fell one standard deviation below the mean change score.
State Depression--Improve: subjects whose state depression change score from pre- to post-exercise fell one standard deviation above the mean change score.

State Depression--No change: subjects whose state depression change score from pre- to post-exercise fell one standard deviation below the mean change score.

Results within each dependent variable, i.e., trait anxiety, trait depression, state anxiety, state depression, were analyzed independently.

Trait Anxiety

Using Wilks' Lambda as the test statistic, the results produced an overall value of 0.8484031 and a corresponding chi-square of 14.714 (df = 3, p < .002). This indicates that the group that improved (i.e., decreased) on trait anxiety differed significantly from the group that showed no change in terms of the predictor variables. Means and standard deviations for each variable are provided in Table VIII.

To determine the source of this between-group variance, stepwise multiple discriminant analysis was used as the post hoc test. A canonical correlation of .389 was obtained indicating that 15% (i.e., R squared) of the variance between those who experienced a decrease in anxiety after the 10-week period and those who did not could be explained by this combination of variables. Further inspection
**TABLE VIII**

MEANS AND STANDARD DEVIATIONS OF PSYCHOBIOLGIC VARIABLES FOR SUBJECTS FALLING ONE STANDARD DEVIATION ABOVE AND BELOW THE MEAN CHANGE SCORE ON TRAIT ANXIETY OVER THE 10-WEEK PERIOD

<table>
<thead>
<tr>
<th>Psychobiologic Variables</th>
<th>Improved (+1 SD of X)</th>
<th>No Change (-1 SD of X)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>SD</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>20.880</td>
<td>9.061</td>
</tr>
<tr>
<td>Run (seconds)</td>
<td>931.420</td>
<td>203.745</td>
</tr>
<tr>
<td>Health Locus of Control</td>
<td>27.520</td>
<td>4.454</td>
</tr>
<tr>
<td>Attitude Toward Physical Activity for Health &amp; Fitness</td>
<td>46.000</td>
<td>7.010</td>
</tr>
<tr>
<td>Trait Anxiety</td>
<td>13.820</td>
<td>6.558</td>
</tr>
<tr>
<td>Trait Depression</td>
<td>13.920</td>
<td>11.428</td>
</tr>
<tr>
<td>Attraction to Physical Activity</td>
<td>31.160</td>
<td>10.601</td>
</tr>
</tbody>
</table>
revealed that only three of the nine variables made a significant contribution to group separation. Estimation of physical ability was entered into the discriminant equation first, followed consecutively by trait anxiety and trait depression. These results are summarized in Table IX.

**TABLE IX**

**STEPWISE DISCRIMINANT FUNCTION ANALYSIS OF PSYCHOBIOLOGIC VARIABLES FOR TRAIT ANXIETY**

<table>
<thead>
<tr>
<th>Step No.</th>
<th>Variable Entered</th>
<th>Wilks' Lambda</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Estimation</td>
<td>0.904849</td>
<td>0.0026</td>
</tr>
<tr>
<td>2</td>
<td>Trait Anxiety</td>
<td>0.868913</td>
<td>0.0018</td>
</tr>
<tr>
<td>3</td>
<td>Trait Depression</td>
<td>0.848403</td>
<td>0.0021</td>
</tr>
</tbody>
</table>

To determine the ability of this linear combination of estimation of physical ability, trait anxiety, and trait depression to accurately classify group membership the classification function was employed. Results of this procedure indicate that 67.74% of all cases could be correctly assigned with 72% of the no change group and 64% of the improved group being correctly classified.
Trait Depression

The Wilks' Lambda statistic indicated an overall value of 0.8136990 and an associated chi-squared of 12.679 (df = 3, p < .0054). Therefore, the null hypothesis of no difference between groups was again rejected. Means and standard deviations for each variable are shown in Table X.

The stepwise multiple discriminant analysis was again used to determine the source of this between-group variance. A canonical correlation of .432 was obtained indicating that 19% of the variance between those who experienced a decrease in depression after the 10-week period and those who did not could be explained by this combination of variables. Again, only three of the eight variables significantly discriminated between the two groups. Trait anxiety was the first variable entered into the equation followed by health locus of control and body fat percent, respectively. These results are summarized in Table XI.

The classification function indicated that the combination of trait anxiety, health locus of control, and body fat percent accurately assigned 67.69% of all cases to their proper group with 71% of the no change group and 66% of the improved group being correctly classified.


<table>
<thead>
<tr>
<th>Psychobiologic Variables</th>
<th>Improved (+1 SD of X)</th>
<th>No Change (-1 SD of X)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>SD</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>21.947</td>
<td>8.624</td>
</tr>
<tr>
<td>Run (seconds)</td>
<td>949.947</td>
<td>217.478</td>
</tr>
<tr>
<td>Health Locus of Control</td>
<td>28.132</td>
<td>4.539</td>
</tr>
<tr>
<td>Attitude Toward Physical Activity for Health &amp; Fitness</td>
<td>45.921</td>
<td>9.562</td>
</tr>
<tr>
<td>Trait Anxiety</td>
<td>17.079</td>
<td>7.339</td>
</tr>
<tr>
<td>Self-motivation</td>
<td>136.132</td>
<td>22.413</td>
</tr>
<tr>
<td>Estimation of Physical Ability</td>
<td>17.658</td>
<td>8.839</td>
</tr>
<tr>
<td>Attraction to Physical Activity</td>
<td>33.368</td>
<td>9.324</td>
</tr>
</tbody>
</table>
TABLE XI
STEPWISE DISCRIMINANT FUNCTION ANALYSIS OF
PSYCHOBIOLOGIC VARIABLES FOR
TRAIT DEPRESSION

<table>
<thead>
<tr>
<th>Step No.</th>
<th>Variance Entered</th>
<th>Wilks' Lambda</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Trait Anxiety</td>
<td>0.892930</td>
<td>0.0078</td>
</tr>
<tr>
<td>2</td>
<td>Health Locus of Control</td>
<td>0.854491</td>
<td>0.0076</td>
</tr>
<tr>
<td>3</td>
<td>Body Fat Percent</td>
<td>0.813699</td>
<td>0.0054</td>
</tr>
</tbody>
</table>

State Anxiety

The Wilks' Lambda test procedure resulted in an overall value of 0.8138939 and a chi-squared of 15.341 (df = 3, p < .001). The null hypothesis was therefore rejected indicating a significant difference existed between the two groups regarding the pre- to post-differences in state anxiety. Means and standard deviations for each variable are provided in Table XII.

The stepwise multiple discriminant analysis revealed a canonical correlation of .431 thus indicating that 18% of the variance between those who experienced a decrease in state anxiety immediately following aerobic exercise and those who did not could be explained by this combination of variables. Again, only three out of the nine variables significantly discriminated between the two groups. Attitude toward physical activity for the purpose of health
TABLE XII

MEANS AND STANDARD DEVIATIONS OF PSYCHOBIOLOGIC VARIABLES FOR SUBJECTS FALLING ONE STANDARD DEVIATION ABOVE AND BELOW THE MEAN CHANGE SCORE ON STATE ANXIETY

<table>
<thead>
<tr>
<th>Psychobiologic Variables</th>
<th>Improved (+1 SD of $\bar{X}$)</th>
<th>No Change (-1 SD of $\bar{X}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\bar{X}$</td>
<td>SD</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>20.766</td>
<td>6.239</td>
</tr>
<tr>
<td>Run (seconds)</td>
<td>855.021</td>
<td>194.535</td>
</tr>
<tr>
<td>Health Locus of Control</td>
<td>28.043</td>
<td>4.530</td>
</tr>
<tr>
<td>Attitude Toward Physical Activity for Health &amp; Fitness</td>
<td>49.532</td>
<td>5.916</td>
</tr>
<tr>
<td>Trait Anxiety</td>
<td>14.255</td>
<td>6.466</td>
</tr>
<tr>
<td>Trait Depression</td>
<td>13.191</td>
<td>11.562</td>
</tr>
<tr>
<td>Self-motivation</td>
<td>149.000</td>
<td>22.461</td>
</tr>
<tr>
<td>Attraction to Physical Activity</td>
<td>36.532</td>
<td>7.885</td>
</tr>
</tbody>
</table>
and fitness was the first variable entered into the equation followed consecutively by trait anxiety and body fat percent. These results are summarized in Table XIII.

### TABLE XIII

**STEPWISE DISCRIMINANT FUNCTION ANALYSIS OF PSYCHOBIOLOGIC VARIABLES FOR STATE ANXIETY**

<table>
<thead>
<tr>
<th>Step No.</th>
<th>Variable Entered</th>
<th>Wilks' Lambda</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attitude Toward Health and Fitness</td>
<td>0.907205</td>
<td>0.0067</td>
</tr>
<tr>
<td>2</td>
<td>Trait Anxiety</td>
<td>0.853375</td>
<td>0.0026</td>
</tr>
<tr>
<td>3</td>
<td>Body Fat Percent</td>
<td>0.813894</td>
<td>0.0015</td>
</tr>
</tbody>
</table>

Results of the classification procedure indicated that the linear model of attitude toward physical fitness, trait anxiety, and body fat percent accurately assigned 70.517% of all cases to their actual group including 68% and 72% of the no change and improved groups, respectively.

**State Depression**

The Wilks' Lambda indicated an overall value of 0.8721226 and a corresponding chi-squared of 6.8413 (df = 2, p < .03). The null hypothesis of no difference between group means regarding state depression was rejected. Means and standard deviations for each variable in both groups are provided in Table XIV.
TABLE XIV

MEANS AND STANDARD DEVIATIONS OF PSYCHOBIOLOGIC VARIABLES FOR SUBJECTS FALLING ONE STANDARD DEVIATION ABOVE AND BELOW THE MEAN CHANGE SCORE ON STATE DEPRESSION

<table>
<thead>
<tr>
<th>Psychobiologic Variables</th>
<th>Improved (+1 SD of $\bar{X}$)</th>
<th>No Change (-1 SD of $\bar{X}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\bar{X})</td>
<td>SD</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>20.400</td>
<td>6.625</td>
</tr>
<tr>
<td>Run (seconds)</td>
<td>917.515</td>
<td>235.771</td>
</tr>
<tr>
<td>Health Locus of Control</td>
<td>27.314</td>
<td>4.581</td>
</tr>
<tr>
<td>Attitude Toward Physical Activity for Health &amp; Fitness</td>
<td>48.400</td>
<td>6.647</td>
</tr>
<tr>
<td>Trait Anxiety</td>
<td>14.514</td>
<td>7.233</td>
</tr>
<tr>
<td>Self-motivation</td>
<td>139.629</td>
<td>22.356</td>
</tr>
<tr>
<td>Estimation of Physical Ability</td>
<td>19.800</td>
<td>7.966</td>
</tr>
<tr>
<td>Attraction to Physical Activity</td>
<td>33.914</td>
<td>8.972</td>
</tr>
</tbody>
</table>
The stepwise multiple discriminant function provided a canonical correlation of .358 indicating that 13% of the variance between those who experienced a pre- to post-decrease in state depression immediately following aerobic exercise and those who did not could be explained by this combination of variables. Only two of the nine variables made a significant contribution to the group separation. Attitude toward physical activity for the purpose of health and fitness was the first variable entered into the equation followed by performance on the 1.5 mile run. These results are summarized in Table XV.

**TABLE XV**

**STEPWISE DISCRIMINANT FUNCTION ANALYSIS OF PSYCHOBIOLOGIC VARIABLES FOR STATE DEPRESSION**

<table>
<thead>
<tr>
<th>Step No.</th>
<th>Variable Entered</th>
<th>Wilks' Lambda</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attitude Toward Physical Fitness</td>
<td>0.897429</td>
<td>0.0194</td>
</tr>
<tr>
<td>2</td>
<td>Run</td>
<td>0.872123</td>
<td>0.0327</td>
</tr>
</tbody>
</table>

The classification function revealed that the combination of the two variables accurately classified 69.81% of all cases into their actual group. The no change group had 72% correct classification and in the improved group, 69% were classified correctly.
Discriminant Function Analysis: Post-exercise Response of High Initial Trait Depression and Trait Anxiety Subjects

Subjects whose level of trait depression or anxiety prior to the 10-week exercise period was greater than one standard deviation of the mean for all subjects were classified as highly trait depressed/anxious. The depressed group totaled 42 out of the entire sample of 301 and the anxiety group totaled 49. This comprised 13.95% and 16.28% of the entire sample for high depression and high anxiety, respectively. Both of these figures are within 2% of the 15.87% figure predicted by the normal distribution.

Data of the high trait depression and anxiety groups was analyzed to determine which variables best discriminated between those who improved (i.e., showed a decrease in depression or anxiety) and those who did not improve following exercise. Improvement is defined as a pre- to post-exercise difference in depression or anxiety which is greater than one standard deviation above the group mean difference. Lack of improvement is defined as pre- to post-exercise difference in depression or anxiety which is less than one standard deviation below the group mean difference.

However, of the four criterion variables (i.e., trait depression, state depression, trait anxiety, and state anxiety), only the state anxiety results allowed a full analysis of the data. The remaining three variables
produced various unexpected results which will be discussed below.

**Trait Depression**

Of the 42 cases classified as high initial trait depression, 29 cases qualified as showing either significant post-exercise improvement or lack of change. The results indicated that 27 of the 29 cases showed improvement and only 2 cases showed no change. Due to this disparity, any meaningful between-group analysis of variance could not be performed. Means and standard deviations for each variable are provided in Table XVI.

**State Depression**

Of the original 42 cases categorized as high initial trait depression, only 17 cases showed significant post-exercise state depression changes in either direction. Twelve of the 17 cases improved significantly and 5 cases showed no change immediately following exercise. A Wilks' Lambda value of 0.6241846 and a chi-square of 6.3267 (df = 3, p < .095) indicated no significant state depression differences between the group classified as demonstrating acute post-exercise improvement and the group showing no change. Thus, no further regression analyses were performed. Means and standard deviations for each variable appear in Table XVII.
TABLE XVI
MEANS AND STANDARD DEVIATIONS OF PSYCHOBIOLOGIC VARIABLES FOR INITIALLY HIGH TRAIT DEPRESSED SUBJECTS FALLING ONE STANDARD DEVIATION ABOVE AND BELOW THE MEAN CHANGE SCORE ON TRAIT DEPRESSION OVER THE 10-WEEK PERIOD

<table>
<thead>
<tr>
<th>Psychobiologic Variables</th>
<th>Improved (N=27) (+1 SD of ( \bar{X} ))</th>
<th>No Change (N=2) (-1 SD of ( \bar{X} ))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \bar{X} )</td>
<td>SD</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>22.704</td>
<td>8.615</td>
</tr>
<tr>
<td>Run (seconds)</td>
<td>976.519</td>
<td>183.151</td>
</tr>
<tr>
<td>Health Locus of Control</td>
<td>28.074</td>
<td>4.420</td>
</tr>
<tr>
<td>Attitude Toward Physical Activity for Health &amp; Fitness</td>
<td>44.593</td>
<td>10.533</td>
</tr>
<tr>
<td>Trait Anxiety</td>
<td>18.370</td>
<td>8.053</td>
</tr>
<tr>
<td>Self-motivation</td>
<td>133.741</td>
<td>24.533</td>
</tr>
<tr>
<td>Estimation of Physical Ability</td>
<td>17.000</td>
<td>9.624</td>
</tr>
<tr>
<td>Attraction to Physical Activity</td>
<td>32.778</td>
<td>10.427</td>
</tr>
</tbody>
</table>
TABLE XVII
MEANS AND STANDARD DEVIATIONS OF PSYCHOBIOLOGIC VARIABLES FOR INITIALLY HIGH TRAIT DEPRESSED SUBJECTS FALLING ONE STANDARD DEVIATION ABOVE AND BELOW THE MEAN CHANGE SCORE ON STATE DEPRESSION

<table>
<thead>
<tr>
<th>Psychobiologic Variables</th>
<th>Improved (N=12) (+1 SD of X)</th>
<th>No Change (N=5) (-1 SD of X)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>SD</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>23.500</td>
<td>5.317</td>
</tr>
<tr>
<td>Run (seconds)</td>
<td>1019.500</td>
<td>236.678</td>
</tr>
<tr>
<td>Health Locus of Control</td>
<td>27.250</td>
<td>4.575</td>
</tr>
<tr>
<td>Attitude Toward Physical Activity for Health &amp; Fitness</td>
<td>45.750</td>
<td>6.930</td>
</tr>
<tr>
<td>Trait Anxiety</td>
<td>18.583</td>
<td>8.878</td>
</tr>
<tr>
<td>Trait Depression</td>
<td>32.917</td>
<td>11.090</td>
</tr>
<tr>
<td>Self-motivation</td>
<td>125.250</td>
<td>21.141</td>
</tr>
<tr>
<td>Estimation of Physical Ability</td>
<td>15.917</td>
<td>6.960</td>
</tr>
<tr>
<td>Attraction to Physical Activity</td>
<td>29.167</td>
<td>8.579</td>
</tr>
</tbody>
</table>
Trait Anxiety

Of the 49 cases classified as high initial trait anxiety, 22 cases fell into the categories of either significant post-exercise reduction in anxiety or no change. Of the 22 cases, however, 19 fell into the improvement category and only 3 in the no change category. Just as with the trait depression group, this extremely unequal amount of cases in each category prevented any fruitful between-group analysis of variance. Means and standard deviations for each variable are found in Table XVIII.

State Anxiety

Seventeen out of 49 high initial trait anxiety cases showed significant post-exercise state anxiety changes in either a positive or negative direction. Eleven of these cases improved following exercise and six cases showed no change. The Wilks' Lambda test procedure resulted in an overall value of 0.4131672 and a chi-square of 11.993 (df = 3, p < .008) indicating an overall significant difference between those who did and those who did not change on state anxiety. Means and standard deviations for each variable can be seen in Table XIX.

The stepwise multiple discriminant analysis was used to determine the source of the between-group variance. A canonical correlation of .766 was obtained indicating that 59% of the variance between those who experienced an acute
TABLE XVIII
MEANS AND STANDARD DEVIATIONS OF PSYCHOBIOLGIC VARIABLES FOR INITIALLY HIGH TRAIT ANXIOUS SUBJECTS FALLING ONE STANDARD DEVIATION ABOVE AND BELOW THE MEAN CHANGE SCORE ON TRAIT ANXIETY OVER THE 10-WEEK PERIOD

<table>
<thead>
<tr>
<th>Psychobiologic Variables</th>
<th>Improved (N=19) (+1 SD of X)</th>
<th>No Change (N=3) (-1 SD of X)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>SD</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>20.895</td>
<td>9.843</td>
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<tr>
<td>Run (seconds)</td>
<td>965.684</td>
<td>206.260</td>
</tr>
<tr>
<td>Health Locus of Control</td>
<td>26.421</td>
<td>4.880</td>
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<tr>
<td>Attitude Toward Physical Activity for Health &amp; Fitness</td>
<td>44.684</td>
<td>8.300</td>
</tr>
<tr>
<td>Trait Anxiety</td>
<td>18.158</td>
<td>6.483</td>
</tr>
<tr>
<td>Trait Depression</td>
<td>21.211</td>
<td>10.310</td>
</tr>
<tr>
<td>Self-motivation</td>
<td>132.368</td>
<td>24.210</td>
</tr>
<tr>
<td>Attraction to Physical Activity</td>
<td>27.895</td>
<td>11.690</td>
</tr>
</tbody>
</table>
### TABLE XIX

MEANS AND STANDARD DEVIATIONS OF PSYCHOBIOLOGIC VARIABLES FOR INITIALLY HIGH TRAIT ANXIOUS SUBJECTS FALLING ONE STANDARD DEVIATION ABOVE AND BELOW THE MEAN CHANGE SCORE ON STATE ANXIETY

<table>
<thead>
<tr>
<th>Psychobiologic Variables</th>
<th>Improved (N=11) (+1 SD of ( \bar{X} ))</th>
<th>No Change (N=6) (-1 SD of ( \bar{X} ))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \bar{X} )</td>
<td>SD</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>20.636</td>
<td>9.447</td>
</tr>
<tr>
<td>Run (seconds)</td>
<td>916.091</td>
<td>308.092</td>
</tr>
<tr>
<td>Health Locus of Control</td>
<td>27.909</td>
<td>5.009</td>
</tr>
<tr>
<td>Attitude Toward Physical Activity for Health &amp; Fitness</td>
<td>45.727</td>
<td>7.669</td>
</tr>
<tr>
<td>Trait Depression</td>
<td>22.273</td>
<td>14.820</td>
</tr>
<tr>
<td>Self-motivation</td>
<td>134.636</td>
<td>24.142</td>
</tr>
<tr>
<td>Attraction to Physical Activity</td>
<td>32.818</td>
<td>9.207</td>
</tr>
</tbody>
</table>
post-exercise reduction in state anxiety and those who did not experience such a change could be accounted for by the variables assessed. Only three of the nine variables significantly discriminated between the groups. Pre-existing trait anxiety was the first variable entered into the prediction equation followed consecutively by pre-existing trait depression and self-motivation. These results are summarized in Table XX.

TABLE XX

STEPWISE DISCRIMINANT FUNCTION ANALYSIS FOR HIGH TRAIT ANXIOUS SUBJECTS CONCERNING STATE ANXIETY

<table>
<thead>
<tr>
<th>Step No.</th>
<th>Variable Entered</th>
<th>Wilks' Lambda</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Trait Anxiety</td>
<td>0.762479</td>
<td>0.0472</td>
</tr>
<tr>
<td>2</td>
<td>Trait Depression</td>
<td>0.502629</td>
<td>0.0081</td>
</tr>
<tr>
<td>3</td>
<td>Self-Motivation</td>
<td>0.413167</td>
<td>0.0078</td>
</tr>
</tbody>
</table>

The classification procedure revealed that the linear combination of the three variables accurately classified 88.24% of all cases into their actual group. This data is displayed in Table XXI.
TABLE XXI
CLASSIFICATION FOR INITIAL HIGH TRAIT ANXIOUS SUBJECTS FALLING ONE STANDARD DEVIATION ABOVE AND BELOW THE MEAN CHANGE SCORE IN STATE ANXIETY

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>Number of Cases</th>
<th>Predicted Group Membership</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No Change</td>
<td>Improved</td>
</tr>
<tr>
<td>No Change</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Improved</td>
<td>11</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18.2%</td>
<td>81.8%</td>
</tr>
</tbody>
</table>

Percent of cases classified correctly: 88.24%.
CHAPTER V

DISCUSSION

Psychobiologic Profile

The intent of the present investigation—to show that people who experience post-exercise positive affect differ psychologically and biologically from those who do not experience such rewards—was not substantially upheld by the results. Although some commonalities exist between selected groups, an overall psychobiologic profile could not be developed to identify individuals who "feel good" following exercise and those who do not. A look at specific results within the three analyses (i.e., regression of all subjects, "improved" versus "no change" groups, and initially high trait anxious and trait depressed groups) reveals the inconsistencies which prevented the development of a psychobiologic profile.

Regression of All Subjects

State Assessment

Two state anxiety and depression inventories were administered 4 weeks apart with the intent of obtaining a more valid picture of exercise-related mood changes than with just a single assessment. However, 22% of the
subjects did not complete both inventories; therefore, comparison between the two inventories was limited to 78% of the sample.

The correlation between the two state assessments of pre-to-post exercise change scores for anxiety and depression was fairly low (i.e., .36 and .25, respectively) indicating that exercise was somewhat unreliable in its relationship to mood changes. The dissimilar reactions of subjects from trial 1 to trial 2 was not totally unexpected given the labile nature of mood states. According to Spielberger (1966), state anxiety reflects how an individual feels at a particular moment and is a transitory, fluctuating state. Although it may be expected that individuals maintain a certain degree of consistency in their behavior, differences between reactions on trial 1 and trial 2 were possibly due to the fact that state anxiety and depression levels were lower on trial 2 than on trial 1. This reduced or more "normal" level may limit the potential of further reductions in these variables since there is less room for improvement.

This notion has received much support from the trait literature which indicates that individuals high in anxiety and depression derive more mental health benefits from exercise than those already scoring in the normal range. Further, perhaps the reduced level of pre-exercise state anxiety and depression on trial 2 is a result of an
additional two weeks of chronic exercise and a total of 6 weeks. Possibly, as is the case with certain physiological variables such as oxygen uptake and neuromuscular strength (Wilmore, 1982), state variables do not reach their threshold of change until approximately 6 weeks of exercise. Indeed, Morgan (1981) and Seemann (1978) suggest that the greatest benefit of chronic exercise lies not in its ability to reduce anxiety but to prevent the repeated daily increase in anxiety.

On the other hand, the reduced level of state anxiety and depression seen on trial 2 may be purely situational, as Spielberger (1966) suggests. That is, situation-specific factors (e.g., inclement weather, fatigue due to late-night cramming for exams) may be responsible for higher initial state anxiety and depression on trial 1. One way to test these hypotheses would be to administer several state assessments throughout the course of the program and track the differences in mood changes.

**Trait Assessment**

Of the four criterion variables, only trait depression yielded information accounting for a statistically significant portion of the variance. Nearly 55% of the variance change in trait depression was accounted for by the variance in the level of pre-existing trait depression. Specifically, subjects who reduced their trait depression had significantly
higher initial levels of trait depression. This finding is consistent with research by Folkins et al. (1972) and Brown et al. (1978) who also found that reductions in depression were of a larger magnitude for subjects who were initially higher in depression from the outset. Results of these studies suggest that individuals who have the most to gain psychologically do indeed show the greatest improvements, a result comparable to the state findings discussed above.

**Improved Group Versus No Change Group**

**Trait Assessment**

The lack of a combination of variables discriminating between those who improved following the 10-week exercise program and those who showed no change on any of the psychobiologic variables indicates the lack of any general psychobiologic profile for either group of individuals. For both trait anxiety and depression, pre-existing trait anxiety was the only common variable emerging as a discriminator between the two groups. Specifically, all subjects who improved had an initially higher level of trait anxiety than subjects who showed no post-program improvement. This finding supports the above results regarding depression but also points out the strong correlation between trait anxiety and trait depression. That is, a high level of pre-existing trait anxiety is not only related to improvement in post-exercise trait anxiety but also to improvement in
trait depression. This result is in agreement with studies by Lion (1978) and Folkins et al. (1972) who also found that individuals higher in trait anxiety from the outset showed the most pronounced reductions in trait anxiety at the conclusion of the exercise program.

**State Assessment**

For both state anxiety and depression, one's attitude toward physical activity for the purpose of health and fitness was the only consistent variable emerging as a discriminator between the improved group and the no change group. That is, subjects who reduced their state anxiety and depression immediately following exercise had a significantly more favorable attitude toward physical activity for the purpose of health and fitness than subjects who showed no such reductions. Although there is no known research dealing with the relationship of this specific attitude and mental states, this finding appears likely in light of research positively correlating expectancies and results (Riddle, 1980; Ness & Patton, 1979). Riddle (1980) found that joggers had stronger beliefs than non-exercisers regarding the consequences of jogging and these beliefs reflected actual positive consequences of jogging. This finding is consistent with that of the present study which revealed that individuals who believed that exercise would improve their health did indeed show an improvement in state anxiety and depression.
This finding could have important implications for exercise program directors attempting to increase adherence of their participants. Along with an exercise prescription based on an individual's medical information, a psychological aspect of exercise could also be of value. Specifically, equal emphasis should perhaps be placed on the benefits of exercise--both physical and psychological--throughout the program. This focus on favorable results may play an important psychosomatic role regarding expectancies; i.e., if participants are expecting to feel good physically and emotiona\nally, they may indeed experience such feelings and thereby attend their exercise program more faithfully. Of course, adherence is the primary desired outcome of any exercise program since the many well-documented benefits cannot be accrued without regular attendance.

**High Initial Trait Anxiety and Trait Depression Groups**

Subjects who were initially high in trait anxiety significantly reduced their levels of trait anxiety during the exercise program. In fact, only 3 cases out of the 49 who were initially high in trait anxiety became more anxious at the end of the 10-week program. As discussed above, this finding is supported by previous research dealing with the effects of exercise on chronic anxiety (e.g., Folkins et al., 1972; Lion, 1978). This result was again attributed to a high level of pre-existing trait anxiety since subjects
overall did not show any change in this variable following the 10-week program.

High trait anxious subjects also significantly reduced their state anxiety levels. This finding is also in agreement with the literature dealing with acute anxiety responses to exercise (e.g., Morgan, 1973, 1976; Morgan, Horstman, Cymerman, & Stokes, 1980; Pistacchio, 1984; Seemann, 1978).

Subjects initially high in trait depression showed a similar response to the high anxiety subjects; i.e., 27 out of 29 cases significantly improved their trait depression scores during the program. These results are supported by a majority of previous studies which also found that chronic exercise was very effective in alleviating depression in clinically depressed subjects (Blue, 1979; Brown et al., 1978; Folkins et al., 1972; Greist, Klein, Eischens, & Faris, 1979; Jasnoski & Holmes, 1981; Sharp & Reilley, 1975).

Such findings have led many psychotherapists to use running or other forms of vigorous exercise as an adjunct therapy to the traditional in-office psychotherapy (e.g., Blue, 1979; Folkins et al., 1972; Greist et al., 1979; Kostrubala, 1976; Lion, 1978; Reuter & Harris, 1980). Exercise is certainly an attractive alternative to tranquilizers, electro-convulsive treatment, or costly psychotherapy for those patients who respond to such activity.
And there is a bonus: the many physiological benefits would be derived as well as the psychological and all for nothing more than the price of a pair of running shoes as opposed to $100 per hour for a psychiatrist's office fee.

Finally, not only did initially high depressed subjects improve, but the mean of all subjects (i.e., including those initially scoring in the normal range at the outset) was significantly lower following the 10-week period. This is especially noteworthy since the class was not designed to be therapeutic in nature but was merely a required physical education class.

Thus, although several inconsistencies in the analyses prevented the development of a psychobiologic profile for individuals experiencing the mood-enhancing effects of exercise, results of the present investigation do confirm previous research stating that aerobic exercise is effective in alleviating trait anxiety and depression in initially high trait anxious and depressed subjects. Additionally, these results suggest that individuals scoring in the "normal" range of depression can enhance this mental state with regular aerobic exercise.

Conclusions and Recommendations

The following are conclusions derived from the present study and recommendations for future research in this area.
Conclusions

1. The present investigation found no general psycho-biologic profile for individuals who experience or do not experience exercise-related mood-enhancement.

2. High trait anxious and depressed individuals have a greater potential for reducing their anxiety and depression through aerobic exercise than do individuals scoring in the normal range of trait anxiety and depression.

3. Individuals with a favorable attitude regarding physical activity for the pursuit of health and fitness show a greater potential for reducing state anxiety and depression following acute exercise than individuals who hold more neutral or negative attitudes.

4. Due to the relatively few individuals not experiencing exercise-related mood-enhancement, several important analyses could not be performed. Although this is an uplifting finding, it prevented the discriminant analysis between the two groups and the possible identification of psycho-biologic differences.

Recommendations

1. Since fleeting biochemical substances have been implicated in the post-exercise mood-elevation phenomenon, it is imperative that post-exercise assessments be administered to all subjects at precisely the same time. Differences in exercise-assessment intervals could be a major confounding factor in post-exercise mood changes.
2. When measuring acute or chronic changes following exercise, instruments specific to that type of change are necessary. Chronic changes must be measured with trait instruments and acute changes must be measured with state instruments.

3. Due to the highly labile nature of state variables, multiple assessments should be taken throughout the test period and correlated as much as possible to situational factors which may be operating in an attempt to reveal the link to mood fluctuations.

4. Future research should focus on alternative variables that as yet have not been tapped. Psychological variables such as one's perception of physical change, one's feeling of mastery after accomplishing a goal, and one's sense of independence from others may be related to post-exercise mood-enhancement.

5. Biochemical changes occurring during and post-exercise also deserve serious attention in future investigations of mood-elevation. Like most scientific questions dealing with human behavior, it is suggested that the determinant of this complex phenomenon will not be just a single factor but rather the interaction of two or more variables--psychological and/or biological--which is responsible.
CHAPTER REFERENCES


APPENDIX A

SS# ____________________________ Date ____________________________

DIRECTIONS: Below is a list of words that describe feelings people have. Please read each one carefully. Circle the number which describes HOW YOU FEEL RIGHT AT THIS MOMENT.

The numbers refer to these phrases: 0 = Not at all  
1 = A little  
2 = Moderately  
3 = Quite a bit  
4 = Extremely

<table>
<thead>
<tr>
<th>Feeling</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Feeling</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angry</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>Discouraged</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Tense</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>Resentful</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Unhappy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>Nervous</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Sorry for things done</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>Lonely</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
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*Make sure you have answered every item.
APPENDIX B

<table>
<thead>
<tr>
<th>SS#</th>
<th>Date</th>
</tr>
</thead>
</table>

DIRECTIONS: Below is a list of words that describe feelings people have. Please read each one carefully. Circle the number which describes HOW YOU HAVE GENERALLY FELT OVER THE PAST 6 MONTHS, NOT INCLUDING TODAY.

The numbers refer to these phrases:

- **0** = Not at all
- **1** = A little
- **2** = Moderately
- **3** = Quite a bit
- **4** = Extremely

<table>
<thead>
<tr>
<th>Feeling</th>
<th>Not at all</th>
<th>A little</th>
<th>Moderately</th>
<th>Quite a bit</th>
<th>Extremely</th>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Unhappy</td>
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<td></td>
<td></td>
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<td>Sorry for things done</td>
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<td></td>
<td></td>
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<tr>
<td>Sad</td>
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<tr>
<td>On edge</td>
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<td>Blue</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Unworthy</td>
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<td></td>
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</tr>
<tr>
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<td>0 1 2 3 4</td>
<td></td>
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<td></td>
</tr>
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</tr>
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<td>Miserable</td>
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<td></td>
<td></td>
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<tr>
<td>Anxious</td>
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<tr>
<td>Gloomy</td>
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<tr>
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<tr>
<td>Worthless</td>
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<tr>
<td>Terrified</td>
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<td>Guilty</td>
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</tbody>
</table>

*Make sure you have answered every item.*
APPENDIX C

SS# ___________________________ Date ___________________________

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you generally feel.

There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

The numbers refer to these phrases: 1 = Almost never  
2 = Sometimes  
3 = Often  
4 = Almost always

<table>
<thead>
<tr>
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<th>1</th>
<th>2</th>
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<th>4</th>
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<tbody>
<tr>
<td>1. I feel pleasant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I tire quickly</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3. I feel like crying</td>
<td></td>
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<tr>
<td>4. I wish I could be as happy as others seem to be</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>5. I am losing out on things because I can't make up my mind soon enough</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>6. I feel rested</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>7. I am &quot;calm, cool, and collected&quot;</td>
<td></td>
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<tr>
<td>8. I feel that difficulties are piling up so that I cannot overcome them</td>
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<td></td>
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<tr>
<td>9. I worry too much over something that really doesn't matter</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10. I am happy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. I am inclined to take things hard</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. I lack self-confidence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. I feel secure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. I try to avoid facing a crisis or difficulty</td>
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<tr>
<td></td>
<td></td>
<td>1</td>
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<tr>
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<td>--------------------------</td>
<td>----</td>
<td>---</td>
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</tr>
<tr>
<td>15.</td>
<td>I feel blue</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>I am content</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Some unimportant thought runs through my mind and bothers me</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>18.</td>
<td>I take disappointments so keenly that I can't put them out of my mind</td>
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<td></td>
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</tr>
<tr>
<td>19.</td>
<td>I am a steady person</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>I become tense and upset when I think about my present concerns</td>
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APPENDIX D

Using the Scales Below, Express What the Concept in the Box Means to You

<table>
<thead>
<tr>
<th>PHYSICAL ACTIVITY FOR HEALTH AND FITNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participating in physical activity primarily to improve one's health and physical fitness.</td>
</tr>
</tbody>
</table>

DIRECTIONS: Place an "X" in the space that best indicates your feelings about participating in physical activity for health and fitness.

1. good | bad
2. worthless | worthwhile
3. pleasant | unpleasant
4. sour | sweet
5. nice | awful
6. sad | happy
7. clean | dirty
8. relaxed | tense
APPENDIX E

ATTITUDE QUESTIONNAIRE (M)

The statements below reflect certain attitudes and interests of persons. Read each statement and decide whether it is true or false as applied to you. Indicate your answer by blackening the appropriate space on the separate answer sheet. In some cases you may have difficulty deciding which response is best, but please make some decision and answer every item. Please do not make an attempt to be consistent in your answers during the test, but respond to each item individually. Even if an item asks about things you haven't experienced, answer it as best you can on the basis of what you have heard, seen, or read.

TRUE or FALSE:

1. I would rather see a play than a movie.
2. I prefer exercising to reading.
3. I generally prefer talking to friends to playing a family table game such as Monopoly.
4. I would much rather play softball than go for a ride in the car.
5. Most of my friends work harder than I do.
6. My body is strong and muscular compared to other men my age.
7. I would be interested in learning to play a musical instrument.
8. Most sports require too much time and energy to be worthwhile.
9. I would have made a good accountant.
10. I am in better physical condition than most men my age.
11. The mechanical properties of motors interest me a great deal.
12. On a Sunday afternoon, I would prefer to go to a movie rather than to go on a picnic.
13. I am quite limber and agile compared to others my age.
14. I often stick up for my own point of view even when no one agrees with me.
15. I enjoy people who talk a great deal.
16. I prefer team sports to individual sports because of the experience of playing with different people.

17. I like to be in sports that don't require a great amount of running.

18. I know that my health improves when I exercise.

19. I just don't have the coordination necessary to look like a graceful skater.

20. I prefer woodworking to tinkering with a motor.

21. One of my favorite interests is listening to music.

22. I would enjoy participating in activities such as cross-country skiing, and channel swimming.

23. Music, art or intellectual pursuits are more refreshing to me than physical activity.

24. I would rather visit an amusement park than watch a tennis match.

25. I like the social opportunities afforded by physical activity programs.

26. I am better coordinated than most people I know.

27. I would enjoy difficult mountain climbing.

28. I love to go to jazz or rock concerts.

29. I don't think that I'd enjoy participating in a judo program.

30. I enjoy the feeling of physical well being one gets after a day's tramp in the woods.

31. I would rather watch a good movie than a hockey match.

32. I would like to belong to some type of exercise group.

33. I am a good deal stronger than most of my friends.

34. I would rather play poker than softball.

35. Compared to other people I am somewhat clumsy.

36. I enjoy hard physical work.
37. I like to engage in recreational exercise rather than in organized, competitive athletics.

38. I am stronger than a good many of my friends.

39. Most people I know think I have very good physical skills.

40. My friends seem to be more physically active than I am.

41. I would rather walk than run through an open meadow or field.

42. Sports provide me with a welcome escape from the pressures of present-day life.

43. I like the rough and tumble of athletic competition.

44. I prefer to watch an exciting basketball game to playing it myself.

45. I rather enjoy the physical risk involved when I play football.

46. I would enjoy participating in a vigorous weight-lifting program.

47. Long distance running would seem to be an enjoyable activity.

48. I doubt that I could ever get into good physical condition.

49. My legs have as much spring as those of champion high jumpers.

50. I don't enjoy doing things that get me sweaty and dirty.

51. I prefer not to participate in physical activities that involve risk of injury.

52. I would enjoy belonging to a whitewater canoe club.

53. When tensions are high, I prefer to lie down and rest rather than to absorb myself in physical activity.

54. If I wanted to, I could become an excellent tennis player.

55. I enjoy performing gymnastic stunts because of the coordinated movements involved.

56. It makes no difference to me how strong or fit I am.

57. I would like to meet more people by engaging in various types of physical activities.
58. After a day at work, I prefer to take it easy instead of participating in vigorous sport activities.

59. It is difficult for me to catch a thrown ball.

60. With a fair amount of practice I could maintain a high bowling average.

61. I enjoy the discipline of long and strenuous physical training.

62. I can run faster than most of my friends.

63. Watching an athletic contest provides a welcome relief from the cares of life.

64. With practice I could become a very good golfer.

65. I have more important things to do than spend time on developing and maintaining physical fitness.

66. I would rather run in a track meet than play badminton.

67. I could do better at long distance hiking than the average man of my age.

68. I exhibit a fair amount of leadership in a sports situation.

69. I lack confidence in performing physical activities.

70. Even with practice I doubt that I could learn to do a handstand well.

71. Playing tennis appeals to me more than does golfing.

72. I can run for longer distances than most men of my age.

73. I'm a natural athlete.

74. The thought of getting sweaty and dirty often keeps me from exercising.

75. I love to run.

76. Getting into good physical shape takes too much effort to be really worth it.

77. I have a strong throwing arm for baseball or softball.
78. Karate competition must be fun.
79. It would be very difficult for me to learn to do a back dive.
80. I would prefer to listen to a concert than to watch a gymnastics match.
81. I am well-equipped to excel at physical activities.
82. Being strong and highly fit is not really that important to me.
83. Absorbing myself in a good sport activity provides an escape from the routine of a work day.
84. Even with practice I doubt that I could ever learn to do a cartwheel well.
85. Exercise relieves me of emotional strain.
86. I would play sports more often if I didn't get so tired.
87. Probably I could get into good physical condition faster than most men my age.
88. I often doubt my physical abilities.
89. I would rather play touch football than go to an amusement park.
90. Participation in physical activity improves me as a social person.
91. I'm not very good at most physical skills.
92. I enjoy the exhilarated feeling one gets after doing calisthenics.
93. I'm not able to meet many worthwhile people through participation in sports.
94. Poor timing handicaps me in certain physical activities.
95. I am a natural leader in sport activities.
96. I would rather play active sports like soccer and basketball than participate in activities like badminton and softball.
97. I believe it is important that a person belongs to a group that participates in sport activities together.
98. I would rather watch either a baseball or basketball game than visit a museum or art gallery.

99. Target archery appeals to me more as an activity than does tennis.

100. I believe one of the greatest values of physical activity is the thrill of competition.
This is a questionnaire designed to determine the way in which different people view certain important health-related issues. Each item is a belief statement with which you may agree or disagree. Beside each statement is a scale which ranges from strongly disagree (1) to strongly agree (6). For each item we would like you to circle the number that represents the extent to which you disagree or agree with the statement. The more strongly you agree with a statement, then the higher will be the number you circle. The more strongly you disagree with a statement, then the lower will be the number you circle. Please make sure that you answer every item and that you circle only one number per item. This is a measure of your personal beliefs; obviously, there are no right or wrong answers.

Please answer these items carefully, but do not spend too much time on any one item. As much as you can, try to respond to each item independently. When making your choice, do not be influenced by your previous choices. It is important that you respond according to your actual beliefs and not according to how you feel you should believe or how you think we want you to believe.

<table>
<thead>
<tr>
<th>Item</th>
<th>Statement</th>
<th>Scale</th>
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<tbody>
<tr>
<td>1</td>
<td>If I get sick, it is my own behavior which determines how soon I get well again</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>2</td>
<td>No matter what I do, if I am going to get sick, I will get sick</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>3</td>
<td>Having regular contact with my physician is the best way for me to avoid illnesses</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>4</td>
<td>Most things that affect my health happen to me by accident</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>5</td>
<td>Whenever I don't feel well, I should consult a medically trained professional</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>6</td>
<td>I am in control of my health</td>
<td>1 2 3 4 5 6</td>
</tr>
</tbody>
</table>
7. My family has a lot to do with my becoming sick or staying healthy .......................... 1 2 3 4 5 6
8. When I get sick, I am to blame .................................................. 1 2 3 4 5 6
9. Luck plays a big part in determining how soon I will recover from an illness ............... 1 2 3 4 5 6
10. Health professionals control my health ................................................. 1 2 3 4 5 6
11. My good health is largely a matter of good fortune ........................................... 1 2 3 4 5 6
12. The main thing which affects my health is what I myself do ................................. 1 2 3 4 5 6
13. If I take care of myself, I can avoid illness .................................................. 1 2 3 4 5 6
14. When I recover from an illness, it's usually because other people (for example, doctors, nurses, family, friends) have been taking good care of me ........................................ 1 2 3 4 5 6
15. No matter what I do, I'm likely to get sick ................................................. 1 2 3 4 5 6
16. If it's meant to be, I will stay healthy ...................................................... 1 2 3 4 5 6
17. If I take the right actions, I can stay healthy ................................................. 1 2 3 4 5 6
18. Regarding my health, I can only do what my doctor tells me to do ............... 1 2 3 4 5 6
APPENDIX G

Read each of the following statements and write by each item the letter of the alternative which best describes how characteristic the statement is when applied to you. The alternatives are:

a. Extremely uncharacteristic of me
b. Somewhat uncharacteristic of me
c. Neither characteristic nor uncharacteristic of me
d. Somewhat characteristic of me
e. Extremely characteristic of me

Please be sure to answer every item and try to be as honest and accurate as possible in your response. Your answers will be kept in the strictest confidence.

1. I'm not very good at committing myself to do things.
2. Whenever I get bored with projects I start, I drop them to do something else.
3. I can persevere at stressful tasks, even when they are physically tiring or painful.
4. If something gets to be too much of an effort to do, I'm likely to just forget it.
5. I'm really concerned about developing and maintaining self-discipline.
6. I'm good at keeping promises, especially the ones I make to myself.
7. I don't work any harder than I have to.
8. I seldom work to my full capacity.
9. I'm just not the goal-setting type.
10. When I take on a difficult job, I make a point of sticking with it until it's completed.
11. I'm willing to work for things I want as long as it's not a big hassle for me.
12. I have a lot of self-motivation.
13. I'm good at making decisions and standing by them.

14. I generally take the path of least resistance.

15. I get discouraged easily.

16. If I tell somebody I'll do something, you can depend on it being done.

17. I don't like to overextend myself.

18. I'm basically lazy.

19. I have a very hard-driving, aggressive personality.

20. I work harder than most of my friends.

21. I can persist in spite of pain or discomfort.

22. I like to set goals and work toward them.

23. Sometimes I push myself harder than I should.

24. I tend to be overly apathetic.

25. I seldom if ever let myself down.

26. I'm not very reliable.

27. I like to take on jobs that challenge me.

28. I change my mind about things quite easily.

29. I have a lot of will power.

30. I'm not likely to put myself out if I don't have to.

31. Things just don't matter much to me.

32. I avoid stressful situations.

33. I often work to the point of exhaustion.

34. I don't impose much structure on my activities.

35. I never force myself to do things I don't feel like doing.

36. It takes a lot to get me going.
37. Whenever I reach a goal, I set a higher one.

38. I can persist in spite of failure.

39. I have a strong desire to achieve.

40. I don't have much self-discipline.
REFERENCES


