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The effects of cognitive restructuring of post-exercise mood

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THE EFFECTS OF COGNITIVE RESTRUCTURING ON POST-EXERCISE MOOD

by

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ABSTRACT

This study examined the effects of a cognitive strategy, involving the use of positive coping statements and negative-thought reframing, on post-exercise mood and rating of perceived exertion (RPE). The effects of listening to music during exercise were investigated on the same variables. Twenty-four untrained subjects completed a VO_2max test and were randomly assigned to a cognitive strategy (CS) group, a music-distraction (M) group, or a no-treatment control group. At a subsequent visit all subjects walked or ran on a treadmill for 20 min at 65% of VO_2max while participating in the assigned condition. The CS group listened to an audiotape that instructed them to engage in positive self-talk and to restructure any negative or maladaptive thoughts regarding oneself or the exercise. Subjects in the M group listened to an audiotape with self-selected music. Measures of affect were collected right before and 20-min post-exercise with a mood instrument, the Exercise-Induced Feeling Inventory (EFI). RPE and heart rates (HR) were collected every 5 minutes during exercise. ANOVAs showed that each condition resulted in significantly greater positive engagement, tranquility, and revitalization following exercise than before. No changes were observed over time, however, for the subscale physical exhaustion. No significant group differences were observed for post-exercise affect on any of the subscales. RPE and HR significantly rose in each group as the exercise session progressed, but no differences emerged between treatments. The rising RPE and HR over time were most likely due to increases in body temperature and fatigue. These findings add to the literature that attests that an acute bout of moderate-intensity exercise is correlated with post-exercise mood enhancement, but do not support a cognitive intervention via positive-coping and negative thought reframing as being a mediating factor.

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A Thesis Presented to the Faculty of

the School of Health Sciences

and Human Performance

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In Partial Fulfillment of the

Requirements for the Degree

Master of Science

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by

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CERTIFICATE OF APPROVAL

MASTER OF SCIENCE THESIS

This is to certify that the Master of Science Thesis of

Susannah B. Fine

submitted in partial fulfillment of the requirements for the degree of Master of Science in Exercise and Sport Sciences at Ithaca College has been approved.

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INTRODUCTION

For the past 15 years researchers in the fields of exercise and health psychology have been investigating the role that exercise plays in enhancing psychological well-being. Accumulated evidence supports the notion that exercise has a favorable impact on short- and long-term mood states (Ewing, Scott, Mendez, & McBride, 1984; Seraganian, 1993; Yeung, 1996). Many studies have suggested that regular exercise may be a useful solo or adjunctive therapy for depression and anxiety (Morgan & Goldston, 1987; Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991; Plante, 1993). Furthermore, studies have asserted that exercise positively affects everyday psychological conditions, such as stress, tension, fatigue, and low self-confidence, thereby minimizing the need for related treatment (Biddle & Mutrie, 1991; deVries, 1987).

Investigation into simple strategies, such as exercise, for the prevention and treatment of psychological disorders warrants attention due to the large numbers of the population involved. The American Psychiatric Association (1994) has estimated that 25% of Americans and Europeans are affected by depression. It is estimated that 12% of Americans suffer from anxiety disorders that disrupt "normal" lifestyle (Bouchard, Shepard, & Stephens, 1993). The rising costs of health-care, the social stigma of mental illness, the lack of awareness of the conditions, and/or the lack of time prevents many individuals from seeking professional help. Exercise may be a viable alternative to traditional treatments for some people. Unlike psychotherapy, which is costly, and/or medications, which are expensive and have negative side effects, exercise can be self-administered, is inexpensive, has few negative side effects, and provides many general benefits for health. However, if exercise is to be touted or prescribed for the prevention and treatment of specific mental health conditions, more needs to be known about the various mechanisms that mediate the beneficial psychological outcomes.

The specific attributes of physical activity that are responsible for improvement in psychological well-being remain unknown (Sime, 1996). Further investigation into the hypothetical mechanisms (e.g., physiological, cognitive, psychological, social) that mediate mental health effects associated with exercise and the specific components of the exercise prescription (e.g., mode, intensity, frequency, duration) is needed (Dishman, 1994; Morgan & Goldston, 1987). At this point in time it is important to remember that the relationship between exercise and mental health is one of association and not causation (Morgan, 1997). If researchers were able to discover the mechanisms that are responsible for the psychological benefits from exercise, respect for exercise therapy, as well as practitioners' interest and use, would increase (Dishman, 1994).

Several theories about mechanisms underlying improved mood following exercise have been proposed but none have provided convincing evidence (Biddle & Mutrie, 1991; Morgan, 1997). Proposed physiological mechanisms include the endorphin hypothesis (e.g., see Hoffman, 1997), the serotonin hypothesis (e.g., see Chaouloff, 1997), the norepinephrine hypothesis (e.g., see Dishman, 1997), and the thermogenic hypothesis (e.g., see Koltyn, 1997). The two main psychologically-based theories are a distraction theory, which proposes that exercise allows "time out" from worry (Bahrke & Morgan, 1978), and a mastery hypothesis, which takes self-esteem, self-efficacy, and achievement into consideration (Sime, 1996). It is possible that both physiological and psychological aspects interact to produce positive mental health outcomes.

Few controlled studies have been carried out to explore the potential psychological processes that may play a role in post-exercise mood improvements. In particular, cognitive factors in exercise-related mood improvement have not been adequately explored. Issues of attentional focus, cognitive appraisal of one's bodily experience during exercise, and self-efficacy have not been investigated in relation to exercise-induced affect (Tuson & Sinyor, 1993). If cognitive aspects were known to influence post-exercise mood, then perhaps cognitive strategies could help those seeking to use exercise for mood-related benefits.

Cognitive strategies are frequently employed by athletes to improve performance, to cope with discomfort and pain, to overcome staleness, and to focus attention (Singer, Murphey, & Tennant, 1993). A major goal in applied sport psychology is to teach the competitor to think "good thoughts" described as "effective thinking" (Newburg, 1992). Outside the field of sport psychology, many psychologists agree that what one thinks affects how one feels (Ellis & Harper, 1975). They reported that much research has shown that when individuals are manipulated to change their thoughts, their emotions and behavior change as well.

Most agree that athletes gain a lot from mental strategies. Some of the same cognitive-behavioral techniques that athletes use, such as cognitive re-structuring, distraction techniques, and positive self-talk, may be useful to non-exercisers to help them manage exercise-induced discomforts. Novice exercisers would not intuitively be aware of the usefulness of such cognitive techniques in coping with an exercise session because they do not have coaches or access to such information.

This investigation explores the issue of whether positive thoughts during exercise influence post-exercise affect. If positive self-talk is found to enhance post-exercise mood states, then those who prescribe exercise could teach this strategy. For example, not only would the client be told how to exercise (e.g., mode, intensity, duration, etc.), but also how to think while exercising.

Purpose of Study

This study was designed to investigate whether the use of cognitive strategies (focused on negative-thought reframing, visualization, and positive self-talk) or listening to music has an effect on post-exercise affect or on rating of perceived exertion during exercise.

Scope of Problem

This study was designed to examine whether a cognitive intervention, focusing on the use of positive coping statements, negative-thought reframing, imagery, and repetition of a mantra, has an effect on post-exercise affect or perceived exertion during exercise. The effects of listening to music while exercising was also investigated in regards to perceived exertion and post-exercise affect.

Sedentary individuals were recruited to be subjects in the likelihood that they would be more likely to have negative thoughts arise during an exercise bout due to less familiarity with physical sensations that accompany exertion. In addition, it was believed they would have fewer expectations regarding post-exercise mood states and be less likely to have predetermined coping strategies during exercise.

All subjects were initially tested for maximal aerobic capacity so that a similar relative workload could be determined for the subsequent experimental visit. Subjects were randomly assigned to 1 of 3 groups: a music-distraction (M) group, a cognitive strategies (CS) audiotape tape group, or a control group. During the experimental visit each participant first completed a mood inventory, then walked or ran on a treadmill at a moderate intensity, and then after sitting quietly for 20 min repeated the mood inventory. Subjects in the cognitive strategies group listened to a prepared audiotape during exercise that encouraged them to use various cognitive strategies. Subjects in the music-distraction group listened to a self-selected music tape while they exercised and the control group had no planned distraction. Analysis of the pre- and post-exercise mood inventories was performed to examine whether mental techniques or music-distraction had any impact above and beyond the typical mood improvement found following a bout of exercise. The Exercise-Induced Feeling Inventory (EFI) was selected for the mood assessment tool due to its ability to assess both positive and negative affective states associated with an acute bout of exercise.

Hypotheses

The major hypotheses for this study are as follows:

1. A cognitive intervention, involving negative thought reframing, used during

an exercise session will enhance post-exercise mood compared to music distraction and to no intervention.

2. Listening to music during an exercise session will improve post-exercise mood compared to no intervention.

3. A cognitive intervention used during an exercise session will result in a lower Rating of Perceived Exertion (RPE) during an exercise session compared to music distraction and to no intervention.

4. Listening to music during an exercise session will result in a lower RPE during the exercise session compared to no intervention.

Assumptions of Study

The following assumptions were made for the purpose of this study:

1. The subjects were representative of typical non-habitual exercisers.

2. The subjects were accurate in describing their thoughts during exercise.

3. Untrained males have similar thoughts during exercise as untrained females (as only females were used to develop the CS tape).

4. Subjects in the cognitive intervention group listened to and made their best attempt to use the cognitive strategies recommended on the prepared tape.

5. The EFI was an appropriate instrument for assessing pre- and post-exercise mood states.

Definitions of Terms

1. Affect: An individual's emotional response to a situation (Kent, 1994), but in exercise psychology literature often the terms mood, psychological benefits, and feelings are used interchangeably (Tuson & Sinyor, 1993).

2. Associative strategy: A method of focusing on internal body sensations and thoughts that enables individuals to continually monitor their internal states (Kent, 1994).

3. Cognitive restructuring: A technique in which a person reinterprets negative self-talk (Annesi, 1996).

4. Cognitive strategies group: Those subjects who listened to a cognitive strategies audiotape during the experimental exercise session.

5. Cognitive strategy: Use of intentional thoughts to produce an outcome such as controlling anxiety or improving performance, often used in sport psychology to identify and avoid or change negative ways of thinking (Kent, 1994).

6. Control group: Those subjects who exercised without any planned intervention.

7. Dissociative strategy: A cognitive technique in which attention is focused on non-performance factors to distract from internal sensations such as discomfort or fatigue (Anshel, 1991).

8. Exercise adherence: Maintenance of participation in an exercise or fitness program (Kent, 1994).

9. Imagery: A psychological technique in which one sees something within one's mind (Annesi, 1996).

10. Intervention: A purposeful strategy or technique designed to cause change (Annesi, 1996).

11. Maximal oxygen uptake (VO_2max): Highest amount of O_2 the body can consume during work for the production of energy, often expressed relative to body weight as ml/kg/min. A true maximal value requires the achievement of established criteria during the exercise test, such as a leveling-off of oxygen uptake from one workload to the next, a respiratory exchange ratio greater than 1.0, and/or attainment of age-predicted maximum heart rate (McArdle, Katch, & Katch, 1996).

12. Music-distraction group: Those subjects who listened to a music audiotape during the experimental exercise session.

13. Rating of Perceived Exertion (RPE): Numerical scale used in exercise situations to assess and describe the subjective feeling of effort required at varying levels of exercise intensity (Borg, 1985).

14. Self-efficacy: The strength of one's conviction that one can successfully execute a behavior required to produce a certain outcome (Bandura, 1977).

15. Self-esteem: A person's inner conviction of competency and worth (Kent, 1994).

16. Self-talk: The inner dialogue that individuals have with themselves, which may be positive or negative (Annesi, 1996). A strategy in which individuals talk to themselves in an attempt to build up self-confidence and convince themselves that they can succeed (Kent, 1994).

Delimitations of Study

1. Subjects were volunteers between the ages of 18 and 37.

2. Subjects were either sedentary or sporadic exercisers.

3. Exercise took place in a controlled laboratory environment (devoid of a social element).

4. Running or walking for 20 min at 60 - 65% VO_2max was the form of exercise used.

5. The EFI was the single instrument used to test affect.

Limitations of Study

1. The results may only be generalized to young adults who do not engage in regular exercise.

2. Feeling states (tranquility, physical exhaustion, positive engagement, and revitalization) were assessed only within the confines of the assessment tool that was used.

3. The results may only apply to those involved in exercise in a controlled environment devoid of a social element.

4. The results may only apply to those walking or running at a continuous moderate intensity for a relatively short duration.

Chapter 2

REVIEW OF LITERATURE

A general conclusion of the Surgeon General's Report (1996) is that physical activity improves mood and reduces symptoms of anxiety and depression. Research suggests that acute exercise is associated with an improved psychological state (Byrne & Byrne, 1993; Tuson & Sinyor, 1993). The exploration into the reasons accounting for the psychological benefits of exercise is still in the early stages. Many questions remain regarding what intensity, frequency, duration, and types of exercise produce the most notable results. Although there has been a considerable amount of research conducted concerning the amount of exercise needed for prevention and treatment of physical ailments, such as heart disease, diabetes, osteoporosis, etc. (American College of Sports Medicine, 1998; Surgeon General's Report, 1996), less attention has been given to the questions regarding the quantity and quality of exercise necessary for various psychosocial outcomes.

Of the many psychological benefits that are positively correlated with regular aerobic exercise (see Bouchard, Shephard, & Stephens, 1993), investigations and review articles have focused on decreased levels of anxiety (Bahrke & Morgan, 1978; Kerr & Vlaswinkel, 1990; Petruzzello et al., 1991), decreased levels of depression (Byrne & Byrne, 1993), improved self-concept and self-esteem (Folkins & Sime, 1981; Plante & Rodin, 1990), and improved affect (Berger & Owen, 1983; Tuson & Sinyor, 1993). In order to gain a better understanding of the relationship between exercise and psychological benefits, research needs to address both: the acute effects of exercise on mood following an isolated bout of exercise, and the effects of habitual, on-going participation in physical activities (chronic effects of exercise) on affective states. In a review of literature (spanning from 1980 to 1990) on exercise and psychological health, Plante and Rodin (1990) found that the more convincing evidence of improved mood state (i.e., less anxiety, stress, tension, fatigue, and depression) came from studies that examined psychological well-being following an acute bout of exercise, versus research that examined mood states associated with a cumulative, ongoing exercise program.

Studies investigating the acute effects of exercise on mood focus on specific aspects of the exercise session (e.g., intensity, duration, environment) or mechanisms that may mediate improved affect (i.e., physiological, social, psychological). Research that investigates acute changes following isolated exercise bouts furthers understanding of whether acute changes occur regardless of training state (i.e., if they occur in the absence of long-term effects of exercise). Some researchers believe it may partially be the repeated bouts of exercise that contribute to better mental health associated with regular exercise, without the training effects per se being necessary (Gauvin & Rejeski, 1993; Rejeski & Thompson, 1993).

Of the many proposed psychological benefits that result from exercise participation, improved affect (i.e., mood states) has been given the most attention in research studies (Tuson & Sinyor, 1993). Still, the potential mechanisms that mediate post-exercise acute affective changes remain unclear. Many questions also remain about whether an optimal intensity, modality, duration, or environment exists, and whether the conditions leading to improved affect differ for trained vs. untrained individuals. This chapter will explore these and related issues in the following sections: (a) effects of acute exercise on mood state, (b) proposed mechanisms of affective change, (c) effect of cognitive strategies on mood and RPE, (d) use of music in sport and exercise, (e) instruments for measuring affect, and (f) summary.

Effects of Acute Exercise on Mood State

Numerous studies have reported that acute bouts of aerobic exercise favorably impact post-exercise mood states (Berger & Owen, 1983; McGowan, Pierce, & Jordan, 1991; Rudolph & Butki, 1998; Roth, 1989); however, there are some studies in which the findings are less clear-cut (Gauvin, Rejeski, Norris, & Lutes, 1997; Steptoe & Bolton, 1988; Steptoe & Cox, 1988). Intensity, duration, and exercise environment, which vary from study to study, are possible confounding factors that may contribute to inconsistency in the findings. Differing results may also be due to methodological problems and/or that many of the studies do not employ true experimental designs (Tuson & Sinyor, 1993). The systematic study of such variables would add to understanding about whether an optimal dose exists for mood improvement and provide information about the role of the exercise setting.

The types of control groups, or absence thereof, used in research investigating the relationship between exercise and affect have varied considerably. In studies looking at changes in mood from pre- to post-exercise, some have used non-exercising control groups that engaged in quiet rest (Bahrke & Morgan, 1978; Ewing et al., 1984; Tate & Petruzzello, 1995), some have used non-exercising control groups involved in an alternate distracting or anxiety-reducing activity (Berger & Owen, 1983; Lichtman & Posner, 1983), and some investigations have simply had groups with varying levels of exercise stimuli (e.g., intensity and duration: Steptoe & Bolton, 1988; Treasure & Newbery, 1998).

<u>Intensity</u>

The precise effects of intensity on positive and negative mood states following exercise are not clear. Some research suggests that anxiolytic benefits may not hold with high intensity exercise (Berger & Owen, 1992; Boutcher, & Landers, 1988; Steptoe & Cox, 1988). In general, research has indicated that less-active individuals (sedentary or low levels of regular physical activity) more commonly experience improved affect following moderate-intensity than high-intensity exercise (Moses, Steptoe, Mathews, & Edwards, 1989; Parfitt, Markland, & Holmes, 1994; Treasure & Newbery, 1998).

Steptoe and Cox (1988) compared high- versus low-intensity exercise on a bicycle ergometer to determine the impact of intensity on post-exercise mood. Using a within-subjects, counterbalanced design, each subject carried out two high-intensity bouts and two low-intensity bouts in an alternating fashion. Mood was assessed prior to and immediately following each trial. This study found that 8-minute bouts of high-intensity exercise resulted in significantly elevated tension/anxiety and fatigue, whereas positive mood states (vigor and exhilaration) were experienced after 8 min of low-intensity exercise. The exercise duration used was much shorter than what is typically employed in research looking at exercise and mood and shorter than what is typically done in real-life bouts. In addition, the mood inventories were performed immediately following exercise, which may have yielded different results than waiting a sufficient amount of time necessary to reduce residual psychophysiological arousal. Research suggests that anxiety may be elevated during and immediately following exercise but that positive mood states develop from 10 min onward (Morgan & Horstman, 1976). Also, in studies comparing exercise with other anxiety-reducing activities (such as meditation, hobby groups, quiet time), there appears to be a time-related element in the exercise conditions where reductions in anxiety do not appear until 15-20 min post-exercise (Tuson & Sinyor, 1993).

Steptoe and Bolton (1988) designed a study to follow-up on the findings reported by Steptoe and Cox (1988) that high-intensity exercise increases negative mood states. They modified some methods of the previous study, such as extending the exercise duration from 8 min to 15 min, assessing mood state at 1-, 5-, and 15-min post-exercise, and choosing a between-subjects design to eliminate interaction between the high and low intensity trials. The results concurred with the earlier study that tension/anxiety was elevated immediately (1-min post-exercise) following the high intensity exercise condition only. However, by 15-min post exercise, tension/anxiety was significantly reduced compared to the pre-exercise rating, further supporting the notion that a brief recovery period is necessary before positive mood changes emerge.

In a meta-analysis examining the anxiety-reducing effects of exercise, Petruzzello et al. (1991) found no significant effects for intensity in relationship to reduced anxiety but did find significant effects for duration. This paper focused solely on the anxiety dimension of affect so does not give a complete assessment of other mood dimensions that may change with exercise bouts.

Duration

Few research studies have systematically explored the effects of duration on mood states and psychological health (Yeung, 1996). Although the American College of Sports Medicine (1998) regularly updates their guidelines on the quantity of exercise recommended for health-related benefits, these are primarily geared towards what is deemed necessary to achieve physiological health-related benefits. The latest published position stand recommends that duration of aerobic training consist of 20-60 continuous or intermittent min (with a minimum of 10-min bouts). From this standpoint, Rudolf and Butki (1998) believed it prudent to investigate whether brief exercise sessions provide psychological benefits because it has been determined that brief cumulative exercise bouts throughout the day bestow cardiovascular health benefits. Specifically, their investigation explored whether a minimum exercise duration was necessary to increase positive affect and decrease negative affect. They compared the effects of 10-, 15-, and 20-min of treadmill running and found that each duration improved feelings of positive well-being and decreased psychological distress. This study used subjects who were regular exercisers and allowed them to control the treadmill speed so that they felt they were working at a "somewhat hard" level, a rating of perceived exertion (RPE) of 13 on the Borg scale (Borg, 1985). The Subjective Exercise Experiences Scale (SEES) was used to assess affect prior to exercise and at 5- and 20-min post-exercise. There was a significant effect for time, with all three conditions showing improvements in positive well-being and decreases in psychological distress from baseline to 20-min post-exercise. No differences were found for any group between baseline and 5-min post-exercise. This study supports earlier research by Hobson and Rejeski (1993) who failed to find any dose-response effects for positive and negative affect, measured by the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), when comparing three durations (10-, 25-, or 40 min) of exercise on a cycle ergometer.

Petruzzello and Landers (1994) compared the effects of 15- and 30-min bouts of treadmill running (at a vigorous intensity) on anxiety reduction and changes in positive and negative affect in response to exercise. They found that both conditions effectively reduced state anxiety, as measured by Spielberger's State Anxiety Inventory (1979), but that neither condition resulted in significant changes in positive or negative affect as measured by the PANAS. The authors noted that the PANAS scale may not have been the most appropriate tool to detect acute affective changes because many of the individual items do not capture commonly associated post-exercise affective states. It is worth noting that this study used very fit male subjects (i.e., much higher than average VO_2max, and accustomed to vigorous exercise) and therefore may not generalize to the average population.

Using meta-analytic techniques, Petruzzello et al. (1991) found that the state and trait anxiety-reducing effect of exercise was significantly less for exercise lasting 20 min or less, than for durations lasting 21 to 30 min. The authors cautioned that this should be looked into more closely, due to the fact that a large portion of the studies with short exercise durations had confounding design issues. Specifically, they point out that the effect sizes in the 0- to 20-min duration category were substantially decreased, because a large percentage of these studies compared exercise with control groups participating in known anxiety-reducing treatments (e.g., relaxation, meditation). When they removed the effect sizes obtained from these studies, the 0- to 20-min category was not significantly different from the other durations. Their final conclusion was that further systematic evaluations of durations less than 20 min was necessary. In their analysis of studies investigating anxiety reduction based on psychophysiological measures of anxiety (e.g., heart rate, blood pressure, EMG, etc.), they found that exercise lasting from 0- to 20-min had significantly larger effect sizes than exercise lasting over 31 min. Although the effect sizes were not as great in the longer durations, anxiety (based on these measures) was still significantly lessened for all exercise durations.

Training Status

The effects of acute exercise on post-exercise mood may differ for aerobically-trained versus untrained (i.e., fit vs. unfit) individuals (Boutcher, McAuley, Courneya, 1997; Parfitt, Markland, & Holmes,1994; Roth, 1989; Steptoe & Cox, 1988; Steptoe & Bolton, 1988). Parfitt et al. (1994) suggested that high-active individuals (exercise more than 3 times per week) experience more positive affect following high intensity exercise than their low-active counterparts (exercise less than twice per week). Following moderate intensity exercise, however, this study found no significant differences between groups. A drawback of this study was that the workload trials were only 4 min in duration. This is much shorter than a real exercise experience and therefore may limit the generalizability of results..

Boutcher et al. (1997) found that trained, compared to untrained subjects, experienced greater positive affect during moderate and hard intensity exercise but that no significant differences existed following exercise. Conversely, untrained subjects showed a greater decrease in negative affect during and following exercise than their trained counterparts. It is impossible to determine from this study whether the different affective responses in trained versus untrained groups stem from physiological or psychological explanations. It is quite possible that physiological adaptations in trained subjects influence perceived exertion, but it is equally plausible that cognitive interpretation of physical sensations (or other mental processes) could differ tremendously between the groups, thereby influencing affect (Boutcher, 1993).

Steptoe and Cox (1988) found no significant differences between fit and unfit groups on any mood measures following moderate or high intensity exercise with the exception that the unfit group experienced greater fatigue following a vigorous exercise trial. When this study was repeated (with a few design modifications) by Steptoe and Bolton (1988), the only significant difference found between fit and moderately fit groups was on the measure of mental vigour. The highly fit participants gave higher ratings of mental vigour and exhilaration following the high intensity trial compared to the moderately fit group.

Environment

Various researchers have suggested that the social environment and human interaction influences exercise-induced affective states (McIntyre, Watson, & Cunningham, 1990; Stephens, 1988). Some research has suggested that increases in positive affect are more likely to be generated in a group exercise environment (Gauvin & Rejeski, 1993). It is quite difficult to gauge how much a laboratory testing environment influences the results of "mood" testing.

Although the affect-enhancing effects of exercise are well documented, there do not appear to be clear-cut exercise dosage or environment recommendations that would apply to all individuals. At this point it is not clear what physiological or psychological mechanisms are involved in generating the improved post-exercise mental state. A better understanding of the mechanisms that are associated with the positive affective changes following exercise would likely be useful on both a theoretical and a practical basis.

Proposed Mechanisms of Affective Change

Several physiological and psychological mechanisms have been postulated to mediate the mood-enhancement effects of exercise. Although none of the hypotheses has been ruled out, strong empirical evidence supporting any one of them is lacking (Dishman, 1994). Much remains to be learned about which mechanisms play a role in post-exercise mood-enhancement. There is no reason to believe that any one mechanism is solely responsible for the psychological benefits associated with an acute bout of exercise. It is quite possible that multiple mechanisms contribute and possibly interact with post-exercise mood improvement (Biddle & Mutrie, 1991). The theories reviewed below describe biochemical and other physiological occurrences that are associated with exercise and may contribute to improved post-exercise affect.

Physiological Mechanisms

In the mid-1970s it was discovered that humans produce chemical substances called endorphins that are very similar to opiates with the same pain and mood-altering potential as morphine (Sforzo, 1988). Endogenous opioids have been associated with increased pain tolerance, affective states such as euphoria, decreases in anxiety, depression, tension, and anger, and a host of systemic controls (McArdle et al., 1996; Sforzo, 1988). Much of the exercise-related research has focused on beta-endorphins, although it is possible that other endogenously produced opioid peptides, such as enkephalins and dynorphins, may play a significant or supportive role (Biddle & Mutrie, 1991). The endorphin hypothesis proposes that an increase in endogenous opioids during exercise mediates the positive mood effects. Investigations examining the endorphin hypothesis have produced mixed results (McGowan, Pierce, Eastman, Tripathi, Dewey, & Olson, 1993).

Two primary methodologies have been pursued in the attempt to understand the correlation between elevated endorphins and exercise-related mood enhancement: a) the measurement of plasma levels of circulating beta-endorphins in relationship to exercise intensity and improvement in various affective measures, and b) to determine whether positive affective change is negated by administration of drugs (naloxone or naltrexone) that block endogenous opioid receptor sites. In general, the findings from these experimental strategies do not provide strong support for the endorphin hypothesis.

Plasma levels of beta-endorphins are known to increase during and following acute aerobic exercise (Steinberg & Sykes, 1985), but numerous studies have suggested that intensity thresholds above 75 to 80% VO_2max are required to raise plasma levels of endorphins significantly (see Sforzo, 1988). Research has suggested that exercise environment and tone (i.e., the level of psychological stress of the task) and major individual differences in endorphin response to exercise (i.e., responders and non-responders) could very well affect serum levels (Allen, 1990). Nevertheless, the question remains that if light to moderate aerobic exercise triggers little elevation in endorphin levels, then some other mechanism must be responsible for mood elevation during and following exercise bouts of less than vigorous intensity or in optimal, non-stressful situations.

The lack of systematic human studies examining endorphins within the central nervous system (CNS), where many believe affective changes are regulated, prevents drawing conclusions on the endorphin hypothesis mediating exercise effects. Exploration into CNS endorphin levels is a difficult area to pursue given that biological and affective changes would most likely occur in response to invasive measurement procedures (Yeung, 1996).

Other research has investigated opiate-antagonist strategies, reasoning that if endorphins are a primary influence on exercise mood enhancement, then substances, such as naloxone, that block endorphins from binding with the receptor site should prevent the hypothesized endorphin effect. Some research has indicated that administering naloxone, an endorphin receptor antagonist, prevents or lessens the exercise-induced positive mood changes (Allen & Coen, 1987; Janal, Colt, Clark, & Glusman, 1984), whereas other studies have shown that naloxone does not have any effect on mood elevation associated with exercise (Farrell, Gustafson, Garthwaite, Kalkhoff, Cowley, & Morgan, 1986; Markoff, Ryan, & Young, 1982). Some criticisms of this approach to researching opioid effects on affective states are that dosages and means of administration are not consistent in the various studies, the mood inventories chosen may be inappropriate, and that naloxone, itself, may cause minor dysphoria (Steinberg & Sykes, 1985; Thoren, Floras, Hoffmann, & Seals, 1990).

Exercise is known to result in increased levels of many other neurochemicals in addition to endorphins. The monamine hypothesis speculates that exercise acts as a stimulus that elevates levels of specific neurotransmitters in the brain that, in turn, result in enhanced mood (Morgan, 1985). Reduced levels of the monoamines norepinephrine and serotonin are associated with anxiety and depression; in fact, the purpose of many anti-depressant drugs is to elevate brain levels to a normal range (Morgan, 1985). Human studies have demonstrated that monoamine concentrations rise as exercise intensity increases and that even low-intensity exercise (40% VO_2max) significantly increases norepinephrine levels compared to rest (Farrell, Gustafson, Morgan, & Pert, 1987; McMurray, Forsythe, Mar, & Hardy, 1987). Other research has shown that exercise elevates brain levels of norepinephrine and serotonin in animals (for a review, see Morgan, 1985). In order to advance this hypothesis much further, systematic research is needed that links physiological responses to post-exercise mood changes.

Another proposed physiological mechanism for affective change focuses on the effects that exercise has on body temperature. The thermogenic hypothesis suggests that core body temperature elevation accompanying exercise results in reduced muscle tension (deVries, 1987), reduced central and peripheral neuronal activity (Morgan & O'Connor, 1988), and decreased state anxiety (Petruzzello et al., 1991), all of which lead to enhanced mood state. Several studies have investigated the effects of passive core temperature elevation (e.g., saunas, warm showers, and induced hyperthermia) and found associated reduced muscle tension levels and decreases in state anxiety and depression (see Koltyn, 1997). Koltyn reviewed numerous studies and found that some research supported an association between post-exercise elevated body temperature and reductions in anxiety whereas others did not. Based on inconsistent findings and lack of systematic testing in this domain, there appears to be insufficient evidence to establish a causal link between exercise-induced core temperature and positive affective change.

<u>Psychological Mechanisms</u>

One aspect of exercise that may contribute to improved mood is that the chosen activity provides "time out" from daily activities or worries (Bahrke & Morgan, 1978). The distraction hypothesis proposes that diversional activities, regardless of whether they are quieting or arousing in nature, may be responsible for reductions in anxiety and overall improved affect (Morgan, 1985). Some studies found that exercise was no more effective than other time-out activities, such as meditation, relaxation, or quiet rest at lessening anxiety levels (Bahrke & Morgan, 1978; Felts & Vaccaro, 1988). Bahrke & Morgan found that vigorous exercise, meditation, and quiet rest all served equally to significantly reduce state anxiety. Raglin & Morgan (1987) replicated and extended that study and obtained similar results but found that anxiety reduction following exercise lasted longer. A meta-analysis by Petruzzello et al. (1991) also showed longer-lasting effects from exercise on anxiety reduction than cognitively-based strategies. Other studies found exercise favorably influenced mood more than a hobby class or quiet rest (Lichtman & Poser, 1983; Roth, 1989). Inconsistencies in findings may be due to lack of random assignment, or other design issues, but illustrate a need for further empirical studies on this hypothesis.

A few other hypotheses have raised other potential factors that influence the exercise-mental health association but have not been adequately investigated using strict experimental designs. The mastery hypothesis proposes that feelings of competence and mastery may lead to a sense of achievement (Ismail & Trachtman, 1973), which may positively influence mood. Other related potential mechanisms are based on perceived self-competence (Harter, 1978), self-esteem (Sonstroem, 1984), and self-efficacy (Bandura, 1977). All of these speculate that successfully completing an exercise session may contribute to a sense of accomplishment or self-worth that may influence affective states (Boutcher, 1993).

Another possibility is that popularized media messages and anecdotal reports about how people feel better after exercise might influence an individual's expectancy regarding post-exercise mood enhancement (Petruzzello et al., 1991). One study that examined this concept found that most participants did have some expectancy regarding mood changes but no significant relationship existed between expectancy and mood alteration following exercise, even though a pre- to post-exercise significant mood change was found (Berger, Owen, Motl, & Parks, 1998).

Finally, it has been suggested that the enjoyment aspect of activity plays a role in generation of positive affect (Sacks , 1993; Wankel, 1993). This mechanism probably does not operate for everyone because many non-exercisers do not enjoy exercise, yet show mood enhancement following an acute bout.

Although all of these hypotheses remain tenable, none has been greatly supported by empirical evidence. It is likely that multiple mechanisms mediate improved affect associated with exercise, possibly in an interactive manner. It is also possible that individuals are differently influenced by the proposed physiological, psychological, and social mechanisms (Morgan, 1985).

Effect of Cognitive Strategies on Mood and RPE

Cognitive techniques, including visualization, imagery, self-talk or cognitive restructuring, attentional focus training, etc., are commonly used by athletes to improve or acquire specific skills and to induce a positive mental state (Weinberg & Gould, 1995). It is presumed that an athlete's cognitive strategies affect both emotional state and the performance of the individual (Pargman, 1993). Cognitive patterns can be changed via education and/or therapy, thereby influencing feeling states (Ellis & Harper, 1975). Yet cognitive techniques are frequently not practiced or taught due to lack of knowledge, lack of belief that they are skills that can be developed, or failure to make time (Weinberg & Gould, 1995). One role of sport psychologists and coaches is to help athletes learn these strategies, but this sort of training is not readily available to the average person exercising for health and fitness.

Facilitated cognitive and perceptual styles during an exercise session could impact on the exercise experience of nonathletes, including their affect. Rejeski (1994) suggested that what people feel and believe about their own participation in an exercise bout cannot be an ignored component in the attempt to understand how exercise influences psychological states. In other words, experience or feelings in a given situation may be tied to how one thinks about it.

Self-talk can be defined as the internal dialogue that an individual engages in (Annesi, 1997). Generally, thoughts can be classified into positive, negative, and neutral.

Individuals frequently do not have conscious awareness of everyday (or situational) thoughts and feelings, but it is believed that they influence emotional state and behavior (Rejeski & Kenney, 1988). Learning techniques to alter negative self-defeating thoughts to positive self-enhancing ones is believed to be an effective way to change one's performance, behavior, and emotional state (Williams & Leffingwell, 1996).

Those who are not physically trained may be particularly vulnerable to discomforts associated with exercise (Rejeski & Kenney, 1988). Some studies show that these individuals, in particular, might benefit from strategies such as cognitive restructuring and dissociation techniques. Kenney, Rejeski, and Messier (1987) reported that a distress management training (DMT) program, involving education on constructive coping skills, dissociation, and relaxation over a 5 week period, enhanced feeling state responses of untrained college women during exercise compared to a control group. They found that subjects in the DMT group reported lower RPE and had more positive affect than a control group during the final minutes of a 15-min submaximal run. Following the submaximal run, the load was increased to 85% VO_2max and subjects were instructed to continue running to a point of volitional exhaustion. During the final minute both groups reported similar RPE values, yet the DMT group had a significantly higher affect score. Although the DMT resulted in significant affect and RPE responses, further analyses showed that the groups did not differ in other assessments of physiological responses (i.e., HR or VO_2), biomechanical efficiency, or performance factors (endurance). Results of this study suggest that DMT helped those subjects ward off or cope with the distress commonly experienced by novice exercisers.

Rejeski (1985) proposed an informational processing model of exercise-induced stress wherein a limited amount of information can occupy attention at one time and the strength of competing sensory and emotional/cognitive cues have the potential to influence RPE and affective response. The focus on physiological cues (e.g., exercise-induced discomforts) versus psychological cues (e.g., pleasant distractors) may therefore be dependent on work intensity. With high-intensity exercise, it is possible that physiological stimuli prevail and may be the predominant input on RPE, whereas at lower intensities psychological input may be more pertinent. The model forwards the idea that pre-task mind set, as well as cognitive and emotional cues during exercise, potentially influence RPE and affective states. The concept that cognitive strategies and attentional focus have the potential to influence physical discomfort, performance, and affect has been explored in several studies. Pennebaker and Lightner (1980) compared a group of subjects who listened to street sounds (i.e., traffic noise and conversation segments) over headphones while exercising with subjects who listened to their own breathing. They found the group with noise distraction experienced less fatigue and discomfort than the group attending to the sounds of their breathing (an associative focus). Following up on that study, Fillingim and Fine (1986) experimentally manipulated attentional focus to either external or internal stimuli during a 1- mile jogging session. A control group was compared with a group instructed to count the number of times a "word-cue" appeared on a recorded cassette tape and a group instructed to monitor their breathing pattern and heartbeat. All groups wore headphones for treatment consistency. They found that the external focus group (with the word-counting distraction) experienced fewer exercise-induced symptoms and reported a more positive mood than the other groups.

Fillingim, Roth, and Haley (1989) investigated the effects of distraction conditions with varying levels of cognitive demand on perceived exertion and performance. They compared a control group with high- and low-demand distraction conditions during cycle ergometry and found no significant differences on any exercise-induced symptoms or performance. The only significant finding was that the high demand group experienced greater post-exercise tension. Other research has suggested that distraction methods that focus attention away from exercise distress can result in enhanced performance (Morgan, Horstman, Cymerman, & Stokes, 1983; Weinberg, Smith, Jackson, & Gould, 1984). Moreover, it appears that less experienced runners benefit more from dissociation strategies in improved performance and decreased fatigue and physical discomforts, compared to experienced runners (Morgan & Pollock, 1977; Okwumabua, Meyers, Schleser, & Cooke, 1983).

Goode and Roth (1993) conducted a descriptive study to investigate the relationship between thoughts during running and post-exercise mood. They developed a "thoughts during running scale" (TDRS) to track the frequency of specific thoughts during a training run by experienced runners and to assess whether thoughts correlated with mood effects. The items in the TDRS loaded on an associative factor (monitoring of bodily responses) or one of four dissociative factors: external surroundings, daily events, interpersonal relationships, and spiritual reflection. The Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) was used to assess mood pre- and post-exercise. Results indicated that various thought domains were correlated with different changes in mood states. Runners who engaged in thoughts about interpersonal relationships showed decreased tension, anxiety, and fatigue, whereas a high degree of associative thought significantly increased fatigue. All dissociative factors, with the exception of spiritual reflection, were correlated with significant increases in vigor. The results of this study suggested that cognitions during exercise do influence post-exercise affective states. It follows that cognitive strategies aimed at changing thought patterns may have some effect on mood following exercise.

In summary, one's ideas, thoughts, and attitudes can affect how one feels. Positive self-talk can be used to foster self-confidence, to increase positive feelings, enhance performance, and increase constructive behavior, to modify arousal level, and to increase motivation (Williams & Leffingwell, 1996), whereas negative thinking can be self-defeating because it is likely to increase self-doubt, self-evaluation, and anxiety (Weinberg & Gould, 1995). Although cognitive-behavioral techniques have been used for decades to counter ineffective thinking habits (Ellis & Harper, 1975), additional research is needed before it can be determined if distraction or thought-control strategies influence post-exercise mood states or enjoyment of exercise. Although there is evidence that exercise can serve as a potential coping strategy, there is a need to understand whether particular conditions, situations, or interventions may help maximize exercise effects (Morgan & Goldston, 1987).

Use of Music in Sport and Exercise

Athletes and coaches report that music may serve as a potent energizer for some individuals (Zaichkowsky & Takenaka, 1993). Fitness exercisers (i.e., non-competitive individuals) frequently listen to music while exercising, and music is considered by many to be an important part of "gym atmosphere." It is speculated that music has the potential to serve as a distractor from the discomforts of exercise and to provide enjoyment (Rejeski & Kenney, 1988). Group exercise programs recommend use of upbeat and stimulating music as a motivational factor for participants (Jordan, 1997) but this has not been studied in a systematic way. Music has also been promoted as a tool for prevention of training monotony (Kodzhaspirov, 1984).

Steptoe and Cox (1988) conducted a study comparing two 8-min high-intensity exercise trials and two 8-min low-intensity exercise trials, one of each session accompanied by music and one by metronome. A within-subjects design was used and the order of the trials was counterbalanced during a single experimental session. The study design allowed them to look at the effects of exercise intensity accompanied by upbeat music vs. a metronome. They found that the metronome trials yielded significantly higher RPE than music. No significant differences in heart rate responses were found nor did music appear to affect mood, other than a slight increase in exhilaration in the music trial.

Boutcher and Trenske (1990) investigated the influence of music versus sensory deprivation (achieved with earplugs and opague goggles) on RPE and affect, across light, moderate, and heavy workloads. The subjects were untrained female undergraduates who were asked to bring music that they would enjoy while exercising. Results indicated that both RPE and affect were influenced by treatment, but not across all workloads. Subjects had lower RPE responses in the music condition compared to sensory deprivation at a light workload only. In contrast, differences in affect were only found in the moderate and heavy intensity workloads with the music condition yielding significant improvements.

Little published research exists on the use of music in relationship to sports performance (Gluch, 1993). Coaches and athletes often describe the use of music in conjunction with imagery and attention control, to increase arousal (i.e., "get psyched up"), or to relax or "unclutter" the mind. Numerous anecdotal reports of the use of music to mentally prepare or to manipulate thoughts and emotional state spurred Gluch to conduct a qualitative study to describe how six athletes (NCAA-Division I) used music as part of their performance preparation. He found that the most frequently cited theme was the use of music to help with self-regulation (i.e., to increase or decrease arousal depending on their perceived needs). The second most reported use of music was to assist with cognitive psyching strategies (e.g., use of music in conjunction with imagery, performance cues, entertainment, concentration, disassociation, and distraction control).

Overall, these studies suggest that music could very well influence psychological factors that impact on exercise-related affect. Further research is needed to investigate the role that music plays in generating positive mood states.

Instruments for Measuring Affect

The choice of mood assessment instruments in exercise studies is a methodological issue that warrants attention. The measurement instruments used to assess psychological outcomes of an acute bout of exercise have been inconsistent (Biddle & Mutrie, 1991). Review articles (Byrne & Byrne, 1993; Plante & Rodin, 1990) illustrate that a wide variety of inventories are used including, but not limited to the POMS, the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970), the PANAS, the EFI (Gauvin & Rejeski, 1993), Multiple Affect Adjective Checklist (MAACL; Zuckerman & Lubin, 1965), and the Subjective Exercise Experiences Scale (SEES; McAuley & Courneya, 1994). The most frequently used assessment instruments in studies involving non-clinical populations are the POMS and the STAI (Tuson & Sinyor, 1993; Yeung, 1996).

The POMS measures 6 subscales: tension, confusion, anger, depression, fatigue, and vigor, with only the latter representing a positive subscale. The STAI only assesses negative mood states. A potential problem of these scales in conjunction with exercise-induced affect is that they primarily concentrate on negative moods and give less attention to positive states that frequently follow exercise. The disadvantage of using such instruments is that the potential of exercise to improve affect and not simply reduce negative affect (e.g., depression, anxiety) is often overlooked. Exercise studies might best use a tool that assesses both positive and negative states because exercise has been associated with improved positive affective states not just alleviation of negative states.

The EFI is a 12-item instrument with a 5-point scale (ranging from 0--do not feel to 4--feel very strongly) that measures four subscale scores: positive engagement (happy, enthusiastic, upbeat); revitalization (energetic, refreshed, revived); physical exhaustion (tired, fatigued, worn-out); and tranquility (calm, peaceful, relaxed). It was designed specifically to assess feeling states that frequently occur during and following an acute bout of exercise. During the development and validation process of this tool, Gauvin and Rejeski (1993) reported that it had good factorial validity (the four-component model accounted for 80% of the variance) and high internal consistency (values ranging from .72 to .91). In addition, these authors found that the instrument had acceptable levels of concurrent, discriminant, and construct validity to assess all of the positive stimulus properties associated with an acute bout of exercise, instead of primarily focusing on negative affective states .

Summary

It is widely accepted that exercise has many favorable effects on psychological state. For example, exercise is correlated with decreased depression and anxiety. It is still unclear what exercise parameters are necessary (e.g., dosage) for the improved affective state to occur. Although numerous physiological (e.g., endorphins, catecholamines, temperature) and psychological (e.g., distraction, mastery) hypotheses have been explored, none is clearly the major contributor that mediate the post-exercise affective changes.

Cognitive techniques, including positive self-talk, associative thinking, and dissociative thinking, are frequently recommended by psychologists and used by athletes to improve skills and performance. Previous studies have found that dissociative cognitive strategies improve endurance performance and improve running times. It has also been noted that dissociative strategies are effective at helping runners cope with physical distress and boredom. The role of these cognitive strategies during exercise has not been adequately explored as a possible contributing mechanism to changes in post-exercise affect.

Likewise, more research is needed examining the influence music has on psychological factors that impact exercise-related affect. Many fitness enthusiasts, as well as athletes and coaches affirm that music has the potential to energize and/or relax. It is important to recognize that music may affect individuals in different ways and the importance of music itself plays a different role in each person's life. As of yet, few exercise studies have explored the effectiveness of music as a distractor or as a mood-enhancer.

Chapter 3

METHODS AND PROCEDURES

The experimental procedures and instruments used in this study are presented in this chapter. The following sections are included: (a) selection of subjects, (b) testing environment, (c) design, (d) procedures, and (e) treatment of data.

Selection of Subjects

Subjects were recruited from the Ithaca College campus and from the greater Ithaca community. Recruitment was solicited with the use of posted flyers (Appendix A), classroom announcements, and word of mouth.

If the volunteers were between the age of 18 and 35 years old, had no known medical problems or symptoms, had not aerobically exercised on a regular basis (defined as averaging two or less times per week) for the previous 6 months, and were not currently taking medication on a daily basis for anxiety or depression, they were accepted for participation in the study. In addition, all subjects met the criteria that they were not more than 25% overweight (determined by use of Metropolitan Life Insurance Tables, 1984) to reduce the risk of orthopedic injuries in participants. The proposed study design and method for selection of subjects was approved by the Human Subjects Research Committee at Ithaca College.

Testing Environment

All phases of the study took place in the Exercise Physiology Laboratory on the Ithaca College campus. Given that the room has no windows, visual distractions were minimal. A "Do Not Disturb" sign was placed on the door during experimental sessions to minimize interruptions and noise. For experimental sessions other than the graded exercise test, only the primary investigator was present and conducted all of the data collection.

Design

During the first visit to the Exercise Physiology Laboratory, all subjects (N = 24) were tested for VO_2max using an incremental treadmill exercise protocol. The VO_2max data were used to determine a relatively similar workload for use by each participant during the subsequent exercise session. In addition, the exercise test gave the subjects an opportunity to become familiar with the RPE scale (Borg, 1985; Appendix B), an instrument that was used during the second visit. At the end of the first visit each subject was randomly assigned to one of three groups: a music-distraction (M) group, a cognitive strategies (CS) group, or a control group. Random assignment was performed by pulling a slip of paper listing a group name from a jar containing all of the scheduled conditions.

Upon arrival for the second visit, called the experimental session, all participants were given standardized instructions to read regarding the visit (Appendix C). They then completed the mood inventory (i.e., EFI) before and following a 30-min walking or running exercise session (including a 5-min warm-up and 5-min cool-down).

VO_2Max Testing

On the first visit, subjects completed the following: (a) a Physical Activity Readiness Questionnaire (PAR-Q), (b) a health/lifestyle questionnaire to gather information about exercise habits and to screen for risk factors or health conditions that would require medical clearance prior to exercise testing (Appendix D), and (c) an informed consent form for participation in the study (Appendix E). Prior to participation, each subject was informed of the potential risks and benefits of his or her involvement in the study and was given the opportunity to ask questions. After the procedures were discussed, each subject was weighed and then given a maximal graded exercise test to assess VO_2max.

Graded exercise testing was performed on a motorized treadmill (Marquette Electronics, Inc., Milwaukee, WI) and followed a modified branching protocol. After a short warm-up on the treadmill, subjects chose a preferred walking or running speed to be used during test. Once the speed was chosen, the test was started. With the treadmill at a 0% grade and increased by 2.5 % at 2-min intervals, the test lasted until the subject reached volitional fatigue. All subjects met established criteria for reaching a true maximal oxygen uptake (Powers & Howley, 1990).

VO_2 was measured using open-circuit spirometry with a metabolic measurement cart (Sensormedics Corp., Yorba Linda, CA). Heart rate was monitored by use of a chest strap (telemetry-type) monitor (Polar, Finland). RPE and heart rate were recorded throughout the test at 2-min intervals.

Upon conclusion of the VO_2max test, each subject was scheduled for a return visit. When the assigned condition was the music group, the participant was informed that he or she could bring music to listen to during the next session. A variety of upbeat tapes (selected by the investigator) were available in case the subjects did not bring their own, which happened in six out of eight cases.

Experimental Session

Upon arrival to the Exercise Physiology Laboratory subjects read the instructions that explained what would take place during the visit (Appendix C). Next, they completed the EFI, a 12-item instrument that measures four distinct feeling states: positive engagement, revitalization, tranquility, and physical exhaustion.

Following completion of the EFI, the subjects put on a heart rate monitor and resting heart rate was recorded. The subjects in the music-distraction and the cognitive strategies group put headphones on so they could listen to their respective tapes. The cord was arranged so as not to be bothersome while on the treadmill. The music-distraction group participants chose the music that they would listen to during the exercise session, whereas the cognitive strategies group listened to the prepared tape.

During the exercise session, the participants walked or ran (depending on their VO_2max test results) at a moderate intensity for a 20-min duration. The exercise session consisted of a 5-min warm-up, 20 min of exercise at 60-65% VO_2max, and a 5-min cool-down. Heart rates were collected at 5-min intervals. RPE was obtained at minutes 10, 15, 20, and 25. Interaction between the investigator and the subject was limited to collecting this information.

Following the 5-min cool-down, the subject sat quietly for 20 min. Heart rates were collected at 5-min intervals. No interaction occurred between the investigator and the subject during this time. At the conclusion of the 20 min, each subject again completed the EFI. Magazines were made available, and all subjects chose to look at them during the 20 min of quiet time.

Upon completion of the last testing session, all subjects were given the opportunity to view the results of the VO_2max test. If they were curious about the purpose of the study, they were informed that at conclusion of the study information would be made available to them.

Thought Collection Session

To assist in the development of the CS audiotape, the first 12 subjects participated in an additional session, called the "thought collection" session, that took place between the VO_2max visit and the experimental session. The purpose of this extra session was to gather information about thoughts during exercise. The information gathered from the subjects was used by the investigator to develop a cognitive strategies audiotape (Appendix F) that was listened to during exercise by the CS group during the experimental session. The original plan was to have all subjects participate in the thought collection session, but it was discontinued after the 12th subject (at this point, all three groups had four subjects in the study) to decrease the time commitment of the remaining participants.

During the thought collection session the participants were given written instructions that explained the procedure that would be followed during the visit (Appendix G). This was to insure that identical instructions were given to all subjects and to minimize contact between the investigator and the participant. A thorough written explanation was given about how to "notice" one's thoughts and how to think of them as falling into many different categories. In addition, subjects were reminded that the information they provided would be kept confidential. After it was determined that the participant understood the instructions, a heart rate monitor was put on and the exercise began.

This exercise session lasted 30 min and was identical to the one used in the experimental session (i.e., 5-min warm-up, 20-min exercise at 65% VO_2max, and 5-min cool-down). Thought collection began at the end of the warm-up and continued until the start of the cool-down. Every 5 min the participant was asked to list the thoughts that were running through his or her mind. At these same intervals the investigator recorded a heart rate and collected a RPE. The subjects had been instructed to let thoughts flow freely and to verbally describe them during each 5-min increment. Interaction between the investigator and the participant during the exercise bout was limited to the exchange of the question, "What has been running through your mind for the last 5 min?" and the participant's reply. At the end of the exercise session, the participants wrote a summary of the thoughts they were aware of during the exercise session on a data collection form (Appendix H).

Development of the Cognitive Strategies Audiotape

In order to develop the cognitive strategies audiotape, it was necessary to determine what non-exercisers thought about during exercise. Subjects reported many negative thoughts during the thought collection session. Unpleasant physical sensations as well as lack of confidence about the session (see Appendix I for a condensed compilation of the thoughts) permeated their reports. Information gathered during the thought collection session validated that negative-thought reframing (also called cognitive restructuring) would be an appropriate cognitive strategy to introduce. The purpose of the tape was to introduce several cognitive strategies that could be used by the exerciser to address negative thoughts.

Prior to collecting data on thoughts during exercise, it was hypothesized that non-exercisers may have recurring counterproductive thoughts or focus on unpleasant physical sensations during a bout of exercise. Numerous conversations with non-exercisers had suggested that unpleasant physical sensations were part of their exercise experience. Indeed, the data collected showed that specific physical sensations, discomforts, bodily responses, or annoyances related to exercise were frequently mentioned thoughts. Other dominant themes that arose during the thought collection were thoughts related to daily events, interpersonal relationships, academic issues, external surroundings, and future plans. All of the reported thoughts fell into similar thought domains reported by Goode and Roth (1993) in their factor analysis of cognitions during running.

The audiotape created was 30 min in length and was designed to be listened to during the entire exercise session (see Appendix F). Dialogue and music were interspersed throughout the length of the tape. Each section of dialogue introduced a cognitive strategy and was followed by 3 to 5 minutes of instrumental background music during which the subject was supposed to practice the strategy most recently discussed.

The first 2 min of the tape encouraged the subject to focus on positive thinking. Music followed, allowing the subject the remainder of the warm-up period to practice positive exercise thoughts. The next portion of the tape discussed negative-thought reframing, particularly in reference to unpleasant sensations sometimes associated with exercise (e.g., sweating, minor aches, etc.). The next few dialogue portions focused on techniques that could help facilitate this, such as positive self-talk, visualization, breath-work, use of a mantra, and affirmations. The final music section at the end encouraged the subjects to congratulate themselves on a job well done.

A recurring and dominant theme stressed throughout the tape was the importance of positive thinking during exercise. The suggestions promoted on the tape were extracted from research reviewing the beneficial effects of optimism on psychological well-being (Cousins, 1977; Scheier & Carver, 1993, Taylor, 1986). Research has suggested that thoughts during exercise influence post-exercise mood (Goode & Roth, 1993), and that thoughts influence feelings (Ellis, 1975). The various cognitive strategies that were introduced, such as self-talk and thought-reframing, imagery/visualization, and attention control, are frequently discussed in the field of sport psychology (Singer et al., 1993; Ungerleider, 1996; Weinberg & Gould, 1995).

Treatment of Data

Psychological data were analyzed to examine differences in post-exercise mood of the three treatment groups (i.e., cognitive strategy tape, music, or control). A 3 X 2 ANOVA (group X time) with repeated measures on the second factor (pre- and post-exercise) was performed for the dependent variables of positive engagement, revitalization, tranquility, and physical exhaustion. The level of significance was set at .05. The raw data can be viewed in Appendix J.

Physiological data were analyzed to examine differences in heart rate and RPE during exercise for the three groups. Separate 3 X 4 ANOVAs (group X time) with repeated measures on the second factor (at 10-, 15-, 20-, and 25-min intervals during exercise) were performed for heart rate and RPE. The level of significance for these analyses was also set at .05. The raw data can be viewed in Appendix J.

Chapter 4

DATA ANALYSIS

This research was designed to investigate whether a cognitive strategy used by untrained individuals during an exercise session would influence post-exercise affect, RPE, or HR. This chapter presents the descriptive statistics and analysis of data in the following sections: (a) description of subjects, (b) analysis of psychological variables, (c) analysis of physiological variables, and (d) summary.

Description of Subjects

Twenty-two females and seven males, ranging in age from 18 to 37 years, volunteered to participate in this study. During the course of the study, one male and three female subjects elected to drop out prior to the final experimental session. One female subject completed all phases of participation but was not included in the data analysis due to inability to adhere to the exercise workload protocol. The remaining 24 participants were included in the data analysis. All of the volunteers were either sedentary or sporadic exercisers, had no known health problems, and did not take medication on a regular basis for depression or anxiety. In addition, none of the subjects was more than 25% overweight. Table 1 contains the descriptive statistics, including age, gender, height, weight, and VO_2max, of those individuals included in the data analysis.

Analysis of Psychological Variables

Separate 3 X 2 ANOVAs (group X time) with repeated measures on the second factor were performed in which the subscale scores of the EFI (i.e., positive engagement, revitalization, tranquility, and physical exhaustion) served as dependent variables. Subscale scores were obtained by summing the numerical values chosen for each of three adjectives within a subscale. The items that made up the positive engagement subscale were enthusiastic, upbeat, and happy. Revitalization consisted of the items energetic, refreshed, and revived. Tranquility consisted of the items calm, peaceful, and relaxed.

Table 1

Participant Characteristics by Group

Variables	Tape (4 Male, 4 Female) M.	SD	Music (8 Female) M	SD	Control (2 Male, 6 Female) M	SD
Age (yrs)	23.4 ±	6.16	21.5 ±	3.85	24.4 ±	5.07
Height (cm)	170.8 ±	13.70	161.9 ±	6.89	165.1 ±	11.11
Weight (kg)	69.2 ±	8.25	60.8 ±	6.67	65.7 ±	14.91
VO2 Max (ml/kg/min)	44.0 ±	7.54	38.3 ±	3.48	41.7 ±	5.60
MaxHR (bpm)	193.4 ±	8.23	194.1 ±	13.16	191.4 ±	7.52
RERmax	1.2 ±	0.02	1.2 ±	0.09	1.1 ±	0.05
Final RPE of GXT	19.1 ±	0.35	18.1 ±	1.27	19.3 ±	0.46

Note. RER = Respiratory Exchange Ratio; GXT = Maximal Graded Exercise Test. RPE was based on the Borg (1985) 6 - 20 scale.

Physical exhaustion consisted of tired, worn-out, and fatigued. Pre- and post-exercise subscale scores for each treatment group are summarized in Table 2.

Positive Engagement

A 3 X 2 ANOVA (group X time) summary table for positive engagement is presented in Table 3. No significant interaction was found between group and time (F (2,21) = 0.32, $p > .05$). Likewise, no significant differences were found for the main effect of treatment (F (2,21) = 1.39, $p > .05$) There was, however, significant improvement in each group from pre- to post-exercise (F (1,21) = 20.84, $p < .05$). These data show that all groups experienced similar and significant improvement in positive engagement over time (i.e., from pre- to post-exercise) as shown in Figure 1.

Revitalization

Data was analyzed for revitalization with a 3 X 2 ANOVA (group X time). The results presented in Table 4 display no significant interaction between group and time (F (2,21) = 2.88, $p > .05$) or main effect of treatment (F (2,21) = 2.0, $p > .05$). Each group, however, showed significant improvement from pre- to post-exercise (F (1,21) = 42.16, $p < .05$). These data show that all groups experienced similar and significant improvement in revitalization over time (see Figure 2).

Tranquility

Data was analyzed for tranquility with a 3 X 2 ANOVA (group X time). The results presented in Table 5 display no significant interaction between group and time (F (2,21) = 1.63, $p > .05$) or main effect of treatment (F (2,21) = 0.44, $p > .05$). There was, however, significant improvement in each group from pre- to post-exercise (F (1,21) = 13.97, $p < .05$). These data show that all groups experienced similar and significant improvement in tranquility over time (i.e., from pre- to post-exercise) as shown in Figure 3.

Table 2

Group Means and Standard Errors for EFI Subscale Scores Pre- and Post-Exercise

Subscale and Group	Time	
	Pre	Post
Positive Engagement		
Tape	4.5 ± 0.63	6.6 ± 0.63
Music	5.4 ± 1.05	7.3 ± 0.59
Control	3.9 ± 1.03	5.3 ± 0.86
Revitalization		
Tape	2.9 ± 1.03	6.0 ± 0.63
Music	3.6 ± 0.73	7.9 ± 0.30
Control	3.1 ± 0.84	4.6 ± 1.02
Tranquility		
Tape	6.6 ± 0.91	8.9 ± 0.77
Music	7.3 ± 0.96	7.9 ± 0.35
Control	5.5 ± 1.09	8.3 ± 0.65
Physical Exhaustion		
Tape	5.5 ± 0.71	4.6 ± 0.93
Music	3.4 ± 0.93	2.8 ± 0.73
Control	5.3 ± 1.11	4.1 ± 1.29

Note. n = 8 for each group.

Table 3

3 X 2 ANOVA (Group X Time) Summary Table for Positive Engagement

Source	SS	df	MS	F	p
Treatment	24.67	2	12.33	1.39	0.272
Subjects within Treatment	186.81	21	8.90		
Time	38.52	1	38.52	20.84	.000*
Treatment X Time	1.17	2	0.58	0.32	0.733
Residual	38.81	21	1.85		

*p < .05.

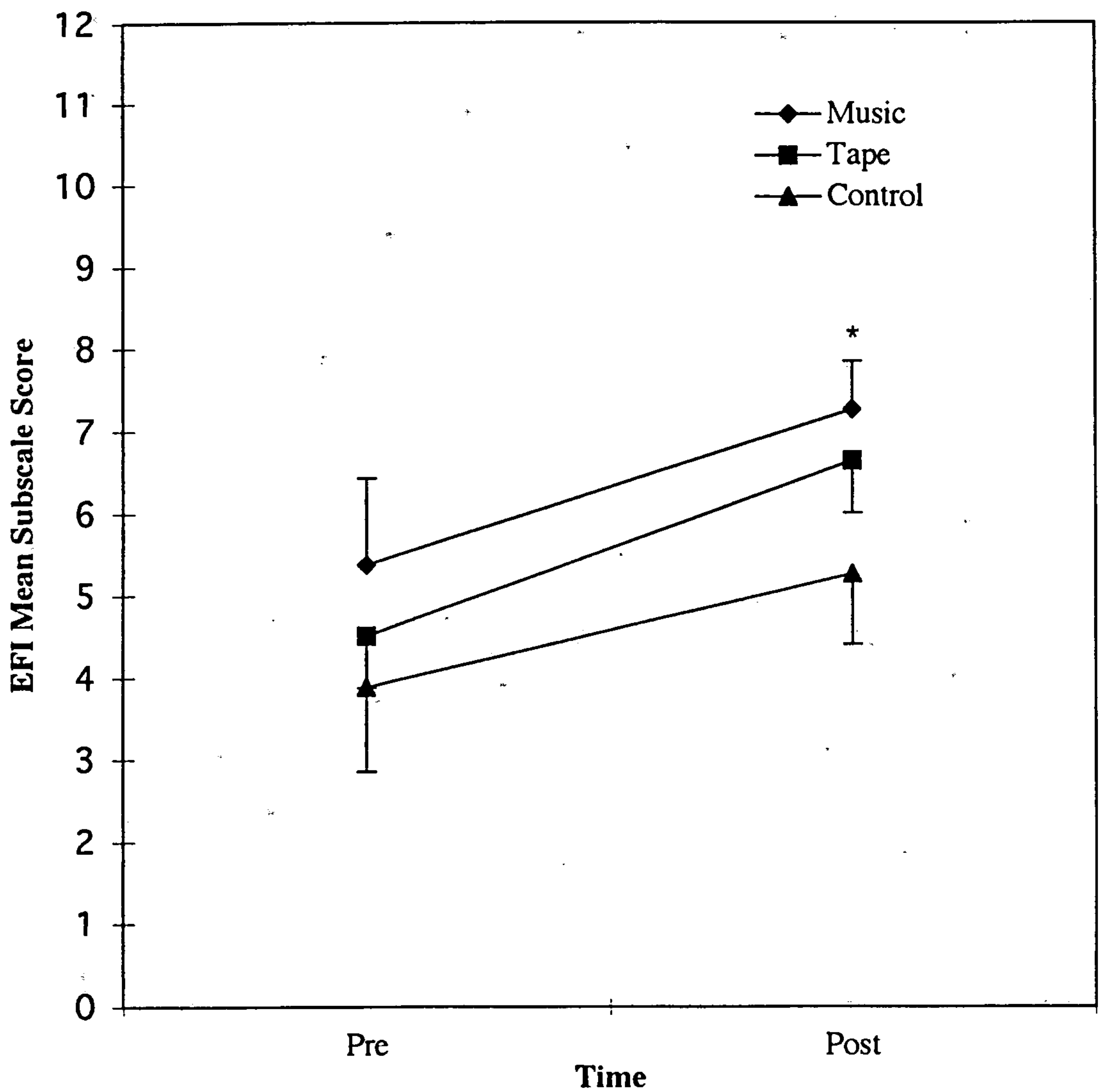

Figure 1. Means and SE for positive engagement scores, pre-exercise, and 20-min post-exercise. * Significant ($p<.05$) increase over time for all groups.

Table 4

3 X 2 ANOVA (Group X Time) Summary Table for Revitalization

Source	SS	df	MS	F	p
Treatment	30.45	2	15.22	2.00	0.16
Subjects within Treatment	159.67	21	7.60		
Time	106.51	1	106.51	42.16	.000*
Treatment X Time	14.57	2	7.29	2.88	0.078
Residual	53.05	21	2.53		

*p < .05.

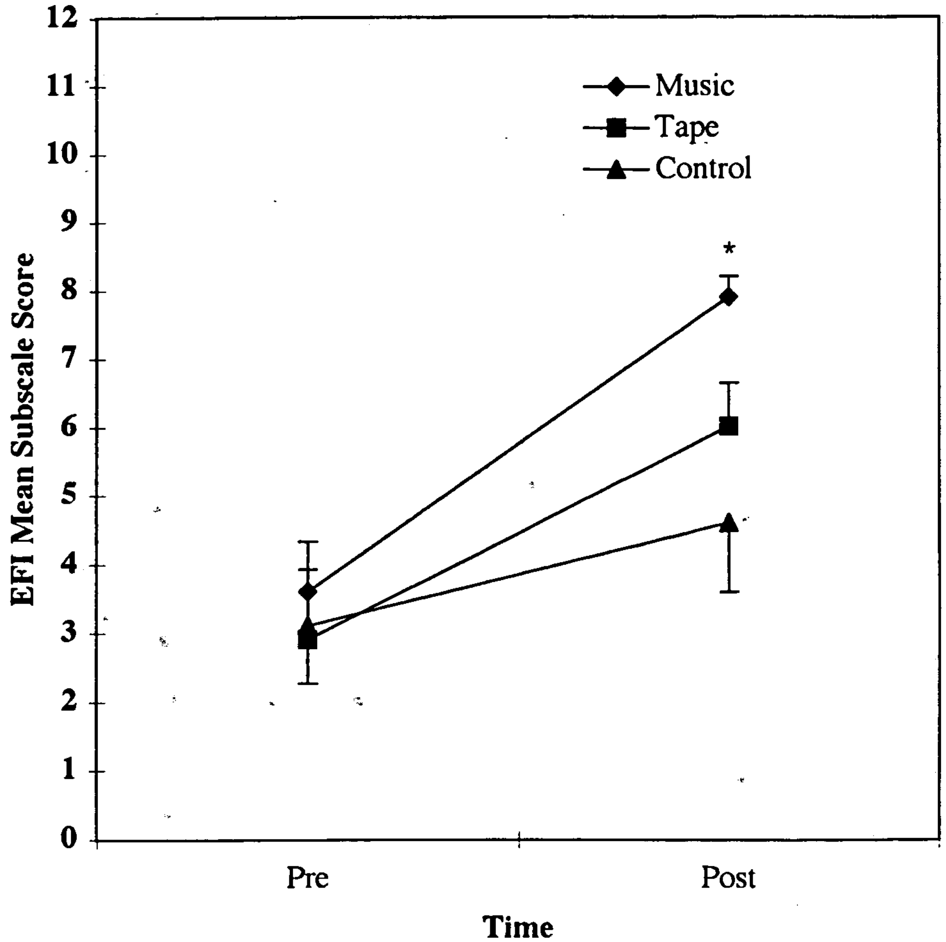

Figure 2. Means and SE for revitalization scores, pre-exercise, and 20-min post-exercise.* Significant ($p<.05$) increase over time for all groups.

Table 5

3 X 2 ANOVA (Group X Time) Summary Table for Tranquility

Source	SS	df	MS	F	p
Treatment	6.79	2	3.40	0.44	0.652
Subjects within Treatment	163.19	21	7.77		
Time	42.19	1	42.19	13.97	.001*
Treatment X Time	9.87	2	4.94	1.63	0.219
Residual	63.44	21	3.02		

*p < .05.

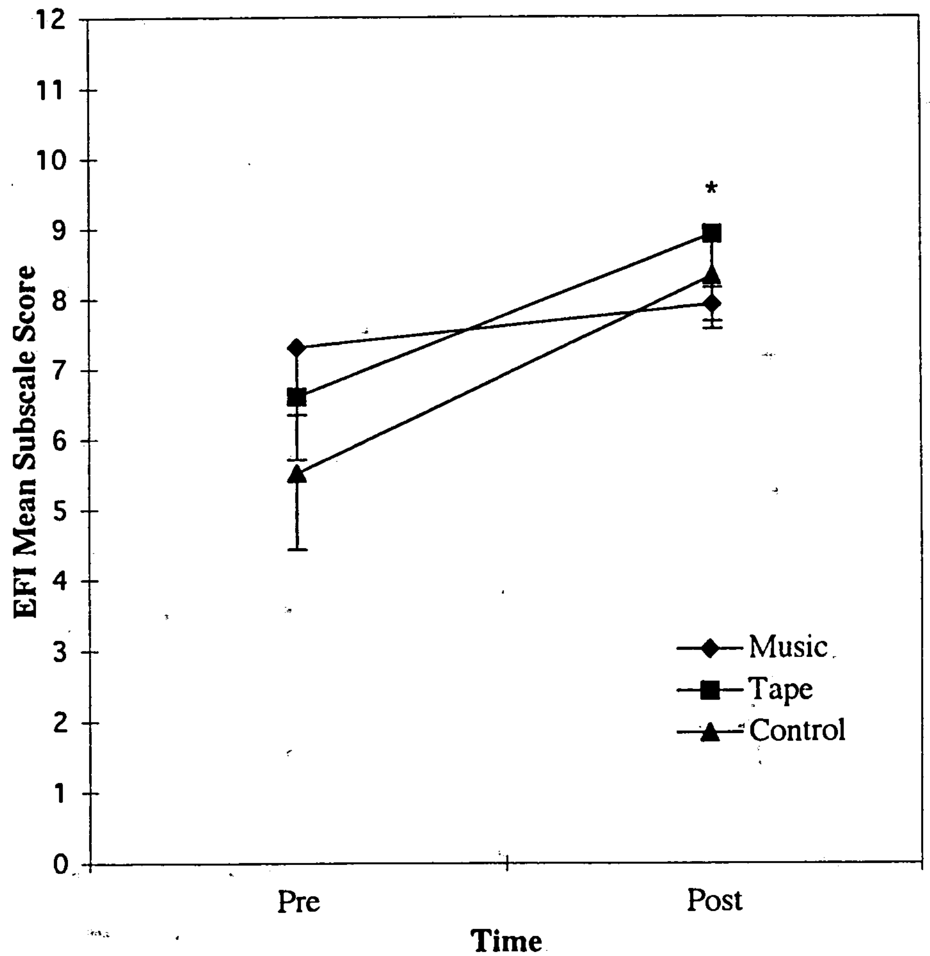

Figure 3. Means and SE for tranquility scores, pre-exercise, and 20-min post-exercise.*Significant ($p < .05$) increase over time for all groups.

Physical Exhaustion

Data analyzed for physical exhaustion using a 3 X 2 ANOVA (group X time) are presented in Table 6. No significant interaction was noted between group and time (F (2,21) = 0.06, $p > .05$) or for the main effect of treatment (F (2,21) = 1.65, $p > .05$). No significant differences were found over time for the subscale physical exhaustion (F (1,21) = 2.25, $p > .05$) (see Figure 4).

The above findings led to the rejection of the following research hypotheses: that a cognitive intervention, involving negative thought reframing, used during an exercise session will enhance post-exercise mood compared to music distraction or no intervention and that listening to music during an exercise session will improve post-exercise mood compared to no intervention.

Analysis of Physiological Variables

Separate 3 X 4 ANOVAs (group X time) with repeated measures on the second factor were performed in which HR and RPE served as dependent variables. Heart rate and RPE values were analyzed at 10-, 15-, 20-, and 25-min during exercise. Values for HR and RPE for each treatment group are summarized in Table 7.

Heart Rate During Exercise

Heart rate data were analyzed with a 3 X 4 ANOVA (group X time) with repeated measures on the second factor (Table 8). No significant differences were found for the interaction between treatment and time (F (6,63) = 0.53, $p > .05$) or for the main effect of treatment (F (2,21) = 0.70, $p > .05$). A significant main effect was found for time (F (3,63) = 44.16, $p < .05$), with heart rates significantly rising in each group as the exercise session progressed.

Table 6

3 X 2 ANOVA (Group X Time) Summary Table for Physical Exhaustion

Source	SS	df	MS	F	p
Treatment	36.17	2	18.08	1.65	0.216
Subjects within Treatment	229.81	21	10.94		
Time	9.19	1	9.19	2.25	0.149
Treatment X Time	0.50	2	0.25	0.06	0.941
Residual	85.81	21	4.09		

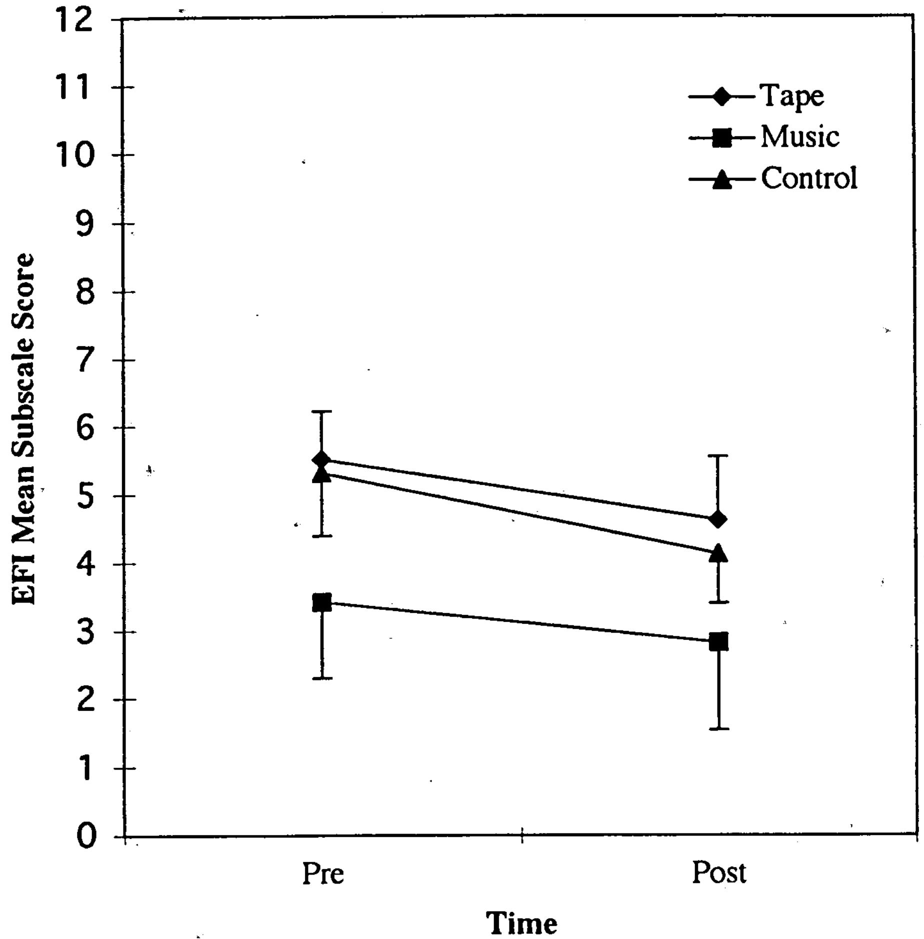

Figure 4. Means and SE for physical exhaustion scores, pre-exercise, and 20-min post-exercise.

Table 7

Group Means and Standard Errors for Heart Rate and RPE During Exercise

	Physiological Data	
Group and Time	Heart Rate (bpm)	RPE
Tape		
RHR	87 ± 3.29	
10-min	160 ± 4.25	11.3 ± 0.42
15-min	166 ± 4.65	13.0 ± 0.42
20-min	167 ± 4.81	13.9 ± 0.60
25-min	169 ± 4.54	14.3 ± 0.62
15-min post	90 ± 2.70	
Music		
RHR	86 ± 4.08	
10-min	159 ± 6.74	11.4 ± 0.33
15-min	165 ± 7.55	12.6 ± 0.37
20-min	168 ± 7.48	13.8 ± 0.63
25-min	168 ± 8.04	13.8 ± 0.31
15-min post	98 ± 5.22	
Control		
RHR	78 ± 5.42	
10-min	150 ± 6.08	11.8 ± 0.35
15-min	155 ± 6.58	13.1 ± 0.33
20-min	156 ± 6.88	14.3 ± 0.45
25-min	160 ± 6.69	15.1 ± 0.54
15-min post	88 ± 5.20	

Note. RHR = resting heart rate. n = 8 in each group. Borg's 6-20 scale (1985) was used to collect RPE scores.

Table 8

3 X 4 ANOVA (Group X Time) Summary Table for Heart Rates during Exercise

Source	SS	df	MS	F	p
Treatment	1743.75	2	871.88	0.70	0.509
Subjects within Treatment	26252.66	21	1250.13		
Time	1160.61	3	386.87	44.16	0.000*
Treatment X Time	27.67	6	4.61	0.53	0.786
Residual	551.97	63	8.76		

*p < .05.

Tukey HSD post-hoc tests found significant mean differences between the first heart rate check at the 10-min point, and at 15-, 20-, and 25-min intervals. Significant mean differences were also found between the 15- and 25-min intervals. Mean differences were not significant between the 15- and 20-min intervals nor between the 20- and 25-min intervals. This suggests that the heart rates were significantly lower for all groups in the earlier stages of exercise. Group mean heart rates observed at baseline, and at 10-, 15-, 20, and 25-min exercise intervals are shown in Figure 5.

RPE During Exercise

A 3 X 4 ANOVA (group X time) with repeated measures on the second factor was performed to analyze the RPE data (Table 9). No significant interaction was found between group and time (F (6,63) = .66, $p > .05$) or for the main effect of treatment (F (2,21) = 0.90, $p > .05$). A significant main effect was found for time (F (3,63) = 43.78, $p < .05$). These data show that there were significantly greater RPE for all groups as the exercise session progressed (see Figure 6). A follow-up analysis, using Tukey's HSD, indicated that significant mean differences were found between the first RPE check at the 10-min point and at the 15-, 20-, and 25-min intervals. Significant mean differences were also found between the 15- and 25-min intervals. Mean differences were not significant between the 15- and 20-min intervals nor between the 20- and 25-min intervals. These findings relate well to the findings of the post-hoc tests performed on the HR data above (i.e., the statistically significant higher heart rates are matched with the statistically significant higher RPE).

These findings led to the rejection of the following research hypotheses: that a cognitive intervention used during an exercise session will result in a lower RPE during the exercise session compared to no intervention and that listening to music during an exercise session will result in a lower RPE during the exercise session compared to no intervention.

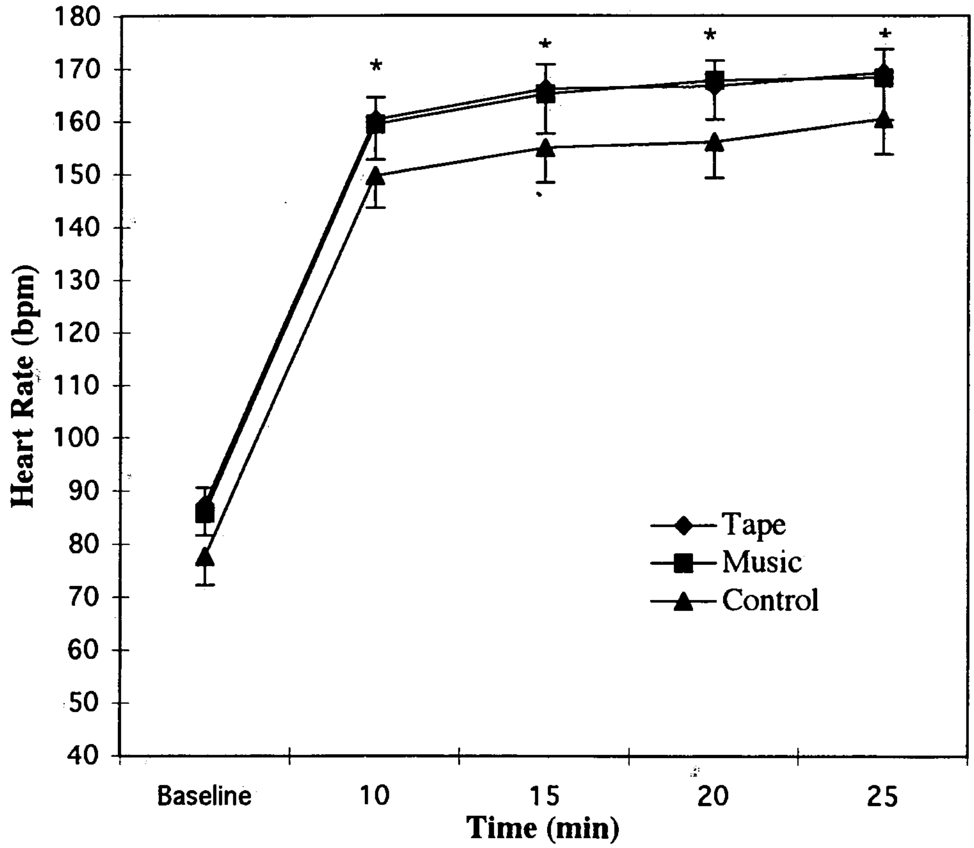

Figure 5. Means and SE for heart rate at baseline and at 10-, 15-, 20-, and 25-min exercise intervals. *Significant ($p < .05$) differences for all groups.

Table 9

3 X 4 ANOVA (Group X Time) Summary Table for RPE During Exercise

Source	SS	df	MS	F	p
Treatment	7.69	2	3.85	0.90	0.422
Subjects within Treatment	82.92	21	4.28		
Time	113.51	3	37.84	43.78	0.000*
Treatment X Time	3.41	6	0.57	0.66	0.684
Residual	54.45	63	0.86		

*$p < .05$.

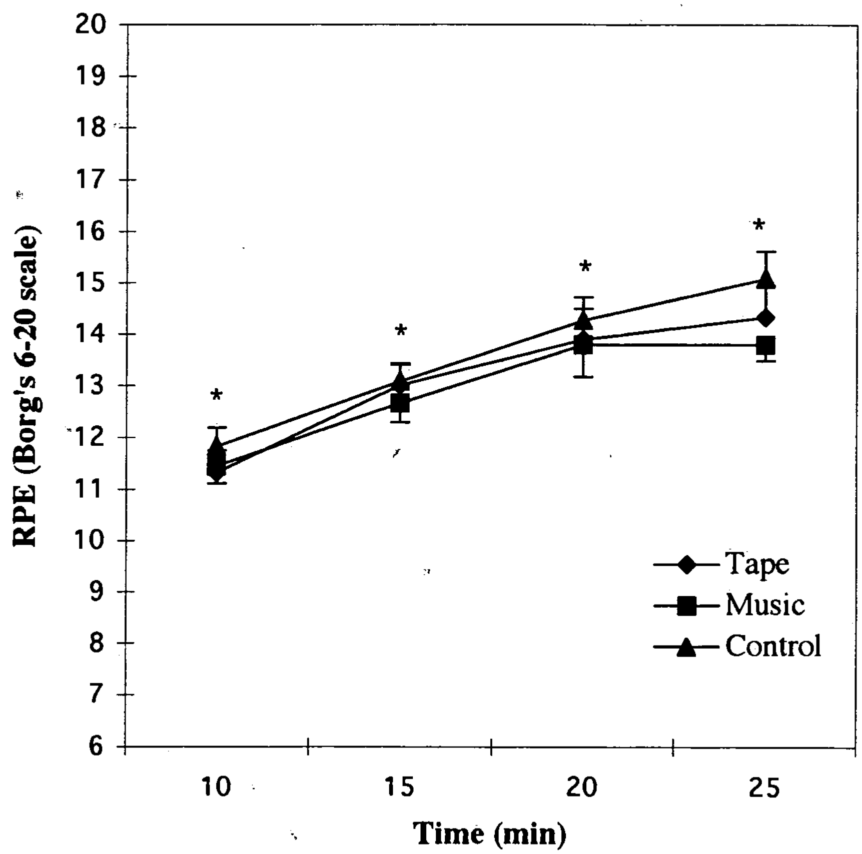

Figure 6. Means and SE for RPE at 10-, 15-, 20-, and 25-min exercise intervals. *Significant ($p < .05$) differences for all groups.

Summary

Analyses of the psychological dependent variables (i.e., the subscale scores of the EFI: positive engagement, revitalization, tranquility, and physical exhaustion) were performed with separate 3 X 2 ANOVAs (group X time). Results from these analyses showed that there were no interaction effects between treatment and time and no main effects for treatment for any of the subscale domains. These results led to the rejection of the hypothesis that there would be a significant difference in post-exercise mood in the CS, M, and control groups related to the treatment during exercise. These analyses did, however, reveal that there were significant main effects for time for the dependent variables positive engagement, revitalization, and tranquility, with all groups improving in these domains from pre- to post-exercise. No significant main effect for time was found for the dependent variable physical exhaustion.

Analyses of heart rates and RPE during exercise showed no interaction between group and time nor a significant main effect for treatment. A significant main effect was found for time with heart rates and RPE significantly rising in synchrony in each group as the exercise session progressed.

Chapter 5

DISCUSSION OF RESULTS

Many people who exercise regularly report that exercise makes them "feel better," and research has supported this post-exercise improved mood phenomenon (see Tuson & Sinyor, 1993). Various physiological and psychological hypotheses have been put forth regarding the mechanisms that mediate post-exercise affective change. These include an endorphin hypothesis (see Sforzo, 1988), which has been popularized by the media, a catecholamine hypothesis (see Morgan, 1997), a thermogenic hypothesis (see Koltyn, 1997), and a distraction or "time-out" hypothesis (Bahrke & Morgan, 1978). The role of attentional focus or the use of cognitive strategies/coping skills has not been systematically explored as a potential mediator of post-exercise affect.

The intention of this study was to explore the possibility that certain cognitive elements play a role in the mediation of post-exercise mood improvement. Specifically, this study investigated the effects of using a cognitive intervention (based on negative-thought reframing, positive self-talk, and other dissociative techniques) during a moderate-intensity exercise session on post-exercise affect and rating of perceived exertion (RPE). The study also investigated the effects of listening to music on the same variables. The results from Chapter 4 will be discussed in relation to the following topics: (a) effectiveness of exercise protocol on post-exercise mood states, (b) effects of a cognitive intervention on post-exercise mood and RPE, (c) effects of music on post-exercise mood and RPE, and (d) summary.

Effectiveness of Exercise Protocol on Post-Exercise Mood States

The exercise protocol used in this study required that the subjects exercise at a moderate intensity for 20 min (plus a 5-min warm-up and 5-min cool-down). The results demonstrated a significant improvement for three of the four psychological variables measured by the EFI after exercise. All three groups (cognitive strategy, music, and control) showed significant changes from pre- to post-exercise for the variables positive engagement, revitalization, and tranquility, but not for physical exhaustion. These results concur with earlier studies that show that an acute bout of exercise is correlated with post-exercise mood improvement (Bahrke & Morgan, 1978; Ewing et al., 1984; Felts & Vaccaro, 1988). These results also lend support to the idea that acute exercise is more consistently related to changes in positive affect than negative affect (Gauvin & Brawley, 1993) given that the EFI subscale, physical exhaustion, was not impacted by exercise in this study.

An inherent problem in this kind of study is the expectancy that mood is supposed to improve following the exercise session thereby influencing the results toward improvement in affect (Gauvin & Brawley, 1993). It was deemed unnecessary to disguise the purpose of the mood inventories that were given before and after exercise because the study was primarily looking for differences between groups, not just simply looking for exercise-induced effects. Given the attention that media (e.g., magazines, TV commercials) focus on this topic, and because no attempt was made during the study to safeguard against the potential expectancy effects, subjects probably were somewhat aware of the purported effects of exercise on mood. Although expectancy effects remain a possibility, this would have influenced all groups equally. Therefore, it should not have influenced the exploration into whether a cognitive intervention or music distraction play a unique role in mediating post-exercise affect.

Effects of a Cognitive Intervention on Post-Exercise Mood and RPE

The present study experimentally introduced a cognitive intervention that encouraged the use of positive self-talk (and negative-thought reframing), as well as other dissociative cognitive strategies, such as use of a mantra (i.e., repeating a personally meaningful word or phrase) and visualization. The cognitive intervention was carried out by having the subjects listen to an audiotape that offered suggestions on what to think about during exercise (Appendix D). The CS group was compared to a M group and a control condition.

It was hypothesized that the CS group would show greater post-exercise affect changes compared to the M and control groups. No significant differences were found in post-exercise mood between the CS, M, or control group for any of the four subscales of the EFI. Exercise-induced mood improvement appears to be a robust event, not readily influenced by thoughts during exercise. One or more of the postulated mechanisms (e.g., endorphins, catecholamines, etc.) may simply override any cognitive element in the contribution to post-exercise mood enhancement.

Another hypothesis was that the cognitive intervention during exercise would result in lower RPE. Analysis of RPE during exercise revealed no significant differences between any of the groups. Although no hypotheses were made regarding HR responses during exercise, these were collected to view in relation to RPE data. Analysis of HR during exercise showed no treatment effect, but as expected, both RPE and HR increased during exercise in all of the groups. The rise in RPE as steady state exercise progressed is not surprising given the parallel rise in HR. The upward drift in HR was most likely a function of increase in body temperature and/or a rise in blood catecholamines (ACSM, 1998). Although distraction techniques are recommended to draw attention away from increased effort, fatigue, and aversive symptoms (King & Martin, 1998), the cognitive intervention was not effective in lowering RPE.

The lack of treatment effect on post-exercise affect and RPE may be related experimental design issues that merit attention. For example, the nature of the cognitive strategies tool, gender effects, the exercise intensity of the session, environmental issues, and/or the EFI instrument are each sources of experimental limitations as discussed below. The other possibility is that it simply does not matter what one thinks about (or listens to) during exercise--the stimulus property of exercise itself may generate a somewhat immutable improved affect.

Implementation and Development of the Cognitive Intervention

A common technique used in research to induce a cognitive strategy has been verbal instructions communicated prior to the experiment. Investigators have reported that subjects may have difficulty adhering to such instructions (Okwumabua et al., 1983). One technique that has successfully induced attentional focus required the subjects to wear earphones to hear their own breathing or a film soundtrack (Wrisberg, Franks, Birdwell, & High, 1988).

In the present study, instructions for the use of the cognitive strategies during the exercise session were delivered while the subjects exercised. Subjects listened to an audiotape with suggestions of what to think about while they were exercising on the treadmill. This method of introducing a cognitive strategy was selected because of the noted methodological problems experienced when verbal or written cognitive strategy instructions were given prior to the exercise session. The lack of differences between groups suggests that the cognitive strategies used in the current study do not influence RPE or post-exercise mood. No manipulation checks were carried out to determine if the cognitive strategies were effectively used by the subjects, so the possibility remains that the tape was simply an ineffective method of conveying the techniques.

It is possible that the method of conveying the cognitive strategy to be used during the exercise session was not sufficient to insure that participants in this study attempted and/or were successful in using the cognitive strategies suggested on the audiotape. Sport psychologists have suggested that the effectiveness of cognitive strategies, such as those used in this study, is dependent on the user's familiarity, commitment, and practice of the strategy (Morgan et al., 1983; Williams & Leffingwell, 1996). It is unlikely that the participants in this study had much prior experience with practicing these strategies during exercise. Therefore, it is possible that the subjects did not gain full benefit from the techniques that were introduced due to lack of familiarity and practice with the strategies.

Contrary to the present results, another study found that a distress management training (DMT) program, involving education on constructive coping skills, dissociation, and relaxation, lowered RPE of novice runners and increased positive affect during a demanding submaximal run compared to a control group (Kenney et al., 1987). The final minute ended in a run to exhaustion and, though both groups reported similar maximal RPE, the DMT group had a significantly higher affect score. Although the DMT resulted in significant affect and submax RPE responses, analysis showed that the groups did not differ in HR values, biomechanical efficiency, or performance factors (endurance). Kenney et al. suggested that the mental techniques introduced in the DMT helped subjects prevent or cope with the distress commonly experienced by novice exercisers. It is noteworthy that the DMT instructions were delivered over weekly meetings that involved education and practice, lending support to the idea that cognitive interventions may require more than simple one-time use by first-time users.

Weinberg et al. (1984) employed several different cognitive strategies in two experiments to test their impact on running and a muscular endurance task. One experiment showed a difference in performance times between groups and one did not. Based on the results of their strategy manipulation check, they suggested that specific training in cognitive strategy techniques is crucial before their impact on performance can be determined. It is possible that, for the subjects participating in the current study, the cognitive strategies were too unfamiliar to be used effectively.

Another point worth considering is the audiotape that was developed for this study was based on the thoughts listed by the first four subjects (see Appendix I). These were fairly consistent in content and were assumed to be generally representative of what non-habitual exercisers may think about during exercise. These four subjects were female, however, and it is possible that they differ slightly in focus from those of a male exerciser. This might impact the results because half the subjects in the CS group were male.

Gender Effects

Gender was not controlled for in the random assignment to the various groups in this study and, unfortunately, differed between groups. The sample size was not large enough to use this as a moderator variable. It is unknown if men and women would have responded differently to the cognitive strategies tape. As mentioned above, the development of the tape was based on the thoughts collected from all females. It was assumed that untrained males would have similar thought patterns.

One study (Wrisberg et al., 1988) using a within-subjects design compared the effects of an experimentally induced attention focus with gender as a moderator variable. They found that RPE response to external focus (watching and listening to a movie) versus self-focus (watching oneself in a mirror while listening to one's own breathing) conditions were dissimilar in men and women. During the walking stage of the activity, males had a higher RPE during the external focus condition whereas women had a higher RPE with the self-focus. These results must be interpreted with caution as the RPE was collected from memory after completion of the activity. Given that attentional focus influenced RPE differently in males and females in that study, it is possible that in the current study the different percentage of males and females in the three groups (i.e., the M group was 100% female, the CS group was 50% female, and the control group was 75% female) affected the results.

Intensity

One possible explanation for the lack of effect of the cognitive intervention is that the exercise intensity may have been too high to allow users to give full attention to the audiotape, thereby precluding the use of the cognitive strategies. Rejeski and Thompson (1993) proposed that when physical demand is excessive, the physiologically-based stimuli suppress the attention an individual can give to cognitive manipulations. A review of an informational processing model (Rejeski, 1985) suggests that high-intensity workloads result in physical cues (i.e., exercise discomforts) that predominate over psychological input, such as social/cognitive cues.

Although a moderate-intensity workload (60 to 65% VO_2max) was calculated for each subject, exercise HR and RPE values suggest that the physical exertion required during the exercise session was perhaps of a higher intensity than intended. In a couple of cases the graded exercise test protocol that was followed did not allow a 60-65% prescription to be precisely extracted (e.g., the starting workload for the GXT was above 65% VO_2max). Therefore, the workload intensity had to be estimated. In some cases environmental factors, such as high humidity in the laboratory, may have influenced the exercise HR. Upon examining exercise HR, one can see they average above 80% HR_{max} (at times approaching 90%), which would be classified as a heavy intensity (> 70% VO_2max). As suggested above, the exercise workload may have been too great for those unaccustomed to high-intensity exercise, thereby precluding good usage of the cognitive strategies that were suggested on the tape.

It is also possible that the physical exertion required for 60 to 65% VO_2max during the exercise was more than what was necessary for a moderate workload for untrained subjects. The VO_2max results indicated that, on average, subjects had less than average aerobic capacity reflecting the selection of sporadic- or non-exercisers. According to ACSM (1995), less fit individuals respond to a relative lower-intensity workout than trained individuals, and even 50% VO_2max could be classified as moderate intensity. Although a dissociative cognitive strategy may be effective to help novice exercisers overcome unfamiliar discomforts, it is possible that the conscious and planned use of specific strategies is more likely to occur at a lower intensity.

Environment

All portions of this study took place in an exercise physiology laboratory. Although no planned intervention was given to the control group, it is possible that the existing environmental stimuli in the laboratory served as potent distractors.

Fillingim et al. (1989) did not find any differences between groups of varying distraction conditions on RPE, on a symptom perception checklist, or on measures of mood (as measured by the POMS). They questioned whether environmental or methodological issues, such as the use of a metronome or the use of slides to have subjects rate RPE, served to influence attentional focus in all groups, including the control. They also pointed out that the experimenter may have distracted all groups to some degree. Likewise, it is possible that subjects in all groups in the current study were distracted by the experimenter. In addition, the control subjects may have used various environmental stimuli in the laboratory (e.g., a scenic poster directly in front of the treadmill) as a means of distraction.

Mood Instrument

It has been suggested that acute exercise may be more correlated with changes in positive affect than negative affect (Gauvin & Brawley, 1993). It seems likely that the EFI, the tool used to measure affect, was an adequate instrument, given that it assesses both positive and negative affective dimensions. The EFI was developed specifically to target the stimulus properties of exercise (Gauvin & Rejeski, 1993). The instrument was, however, developed and validated using a subject pool of regular exercisers. It is possible that other distinct feeling states are experienced and/or predominate in non-exercisers. The POMS and the STAI, which are the more commonly used instruments, focus less on positive dimensions of exercise and are preoccupied with negative dimensions. They may not be the most appropriate mood inventories to use in exercise studies involving habitual exercisers, but perhaps could be more useful for studies involving less experienced exercisers. An inventory that includes equal positive and negative dimensions that arise from exercise would be ideal as it is possible that a cognitive intervention may have more effect on reducing negative affect arising from challenging exercise than on increasing the positive affect in inexperienced exercisers.

Effects of Music on Post-Exercise Mood and RPE

As stated, it was hypothesized that the M group would show greater changes in post-exercise affect, as measured by the EFI, compared to the control condition, but no support was found for this claim. A second hypothesis was that listening to music during exercise would result in lower perceived exertion, but analysis of RPE revealed this also was not the case.

In contrast, Steptoe and Cox (1988) investigated the effects of high- and low-intensity exercise while listening to music or a metronome and found that listening to music resulted in significantly lower RPE. Their results showed no significant differences in HR or mood, although there was a trend toward greater exhilaration in the music condition. Some differences in their study compared to the present one are that the exercise trials were much shorter (8 min) and involved the same upbeat music selection for each subject. Subjects in the present investigation were allowed to bring their own music or to choose from a selection of rock-and-roll tapes that the investigator made available. All of the music chosen tended to be in the rock-and-roll tradition but it is unknown if certain types of music would be more effective than others.

Other research has also noted lowered RPE and improved affect with a music condition. Boutcher and Trenske (1990) found lower RPE in music compared to sensory deprivation groups with low intensity exercise and lower RPE in the music compared to a control group with moderate intensity exercise. No differences in RPE were found with a heavy workload. Interestingly, their heavy workload was classified as 85% maximal HR (as predicted by a submaximal test). Retrospectively, looking at subjects' exercising HR in the current study it is apparent that they were exercising at approximately 85% HR_{max}. It is possible that differences across conditions would have appeared with lower intensity exercise. In contrast to their RPE findings, Boutcher and Trenske found that music compared to sensory deprivation influenced affect at moderate and heavy workloads. Their study was a within-subjects design and affect was measured during exercise with a 10-

point bipolar scale. Although the current research does not support their findings, it is difficult to know the magnitude that differences in methodology had on influencing their findings.

The fact that the present study revealed no significant differences was surprising given the number of anecdotal reports from group exercise participants and instructors that music serves to motivate and exhilarate during exercise. Many solitary exercisers also report using music as a potent distractor from exercise discomforts and boredom.

Summary

This investigation found that music and cognitive strategies were not effective at decreasing RPE or influencing post-exercise affect. In fact, all groups experienced positive affective change following exercise. It is possible that certain aspects of the exercise session (e.g., intensity and/or environment) may have influenced the ineffectiveness of the cognitive strategies or music treatment. Equally possible is the notion that exercise consistently brings about positive affective states, regardless of what one thinks about during the activity.

It is well-documented in the research literature that acute bouts of exercise are correlated with improved mood states, across various types of exercise, intensities, and duration (Yeung, 1996). The results from this study are consistent with other findings that improved mood follows an acute bout of exercise. Previous studies have suggested that these effects appear to hold true regardless of age or gender, though they may vary with environment and training status. This study does not lend support to the suggestion that exercise-induced mood enhancement is influenced by cognition during the exercise session. Perhaps other mechanisms simply play a stronger role in mediating post-exercise mood and overpower any cognitive or psychological factors.

Chapter 6

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study examined the effects of a cognitive strategy, involving the use of positive coping statements during exercise, on post-exercise affect and exercise RPE. The effects of listening to music during exercise were also investigated on the same variables. Twenty-four subjects completed a VO_2max test and were randomly assigned to either a CS group, a M group, or a control group. At a subsequent visit all subjects walked or ran on a treadmill for 20 min at a moderate intensity while participating in the assigned condition. The CS group listened to an audiotape that instructed them to engage in positive self-talk and to restructure any negative or maladaptive thoughts regarding oneself or the exercise. Subjects in the M group listened to an audiotape with self-selected music. Measures of affect were collected pre- and post-exercise using the EFI and RPE was collected every 5 min during exercise.

ANOVA showed that each condition resulted in significantly greater positive engagement, tranquility, and revitalization following exercise. No changes were observed over time for the subscale physical exhaustion. These findings add to the literature that attests that an acute bout of moderate-intensity leads to post-exercise mood enhancement. No significant group differences were observed for post-exercise affect on any of the subscales. RPE and HR significantly rose in each group as the exercise session progressed, but no differences emerged between treatments. The rising RPE and HR over time were most likely due to increases in body temperature and fatigue.

These data did not provide evidence that cognitive strategies enhance post-exercise mood improvement effects. It is possible that methodological shortcomings, such as too high of an exercise intensity, contributed to lack of group differences. On the other hand, post-exercise mood enhancement may simply be a very robust physiologically mediated phenomenon, unaffected by thoughts during the exercise bout. It may be worthwhile to continue exploring whether there is a cognitive element that contributes to the mediation of post-exercise mood enhancement. The potential therapeutic worth of exercise on a variety of mental health conditions warrants continued inquiry into the mechanisms involved and whether there is an ideal intensity or duration. Should cognitive strategies ultimately be found to play a role in influencing post-exercise mood, it would make sense to incorporate these aspects into the exercise prescription.

Conclusions

The following conclusions were made based on the results of this study:

1. A 20-min, moderate-to-high intensity exercise session resulted in improved affect for untrained individuals.

2. A CS intervention, emphasizing negative-thought reframing and positive self-talk, did not enhance post-exercise affect or lower RPE during exercise for untrained individuals.

3. Music, as distraction, did not influence post-exercise affect or lower RPE during exercise for untrained individuals.

Recommendations

The following recommendations are made for future research on this topic:

1. Further testing of the effects of cognitive strategies on post-exercise mood and exercise RPE should be carried out across varying workloads. It is possible that a lower intensity (easy to moderate) workload would allow novice exercisers to focus more on the cognitive strategies because there would be less competition from physiological cues/discomforts based on Rejeski's (1985) notion of competition of cues.

2. It might be worthwhile for future research to test whether cognitive strategies impact on post-exercise mood in a natural setting that is more typical of an actual exercise experience.

3. Investigation of whether cognitive strategies impact on post-exercise mood should be carried out using a different methodology in which participants exercise at a preferred vs. prescribed exercise intensity.

4. Further investigation into the influence of a cognitive intervention on post-exercise affect should be made after sedentary individuals have been trained in using mental techniques that promote positive coping skills and effective distraction strategies.

Appendix A

RECRUITMENT FLIER

If you don't exercise but would like to get started, listen up

Subjects needed for study:

(MEN & WOMEN)

Take part in a research project and, if interested, get a FREE fitness evaluation and exercise prescription consultation.

You might be eligible to participate if:

- *You do not currently exercise on a regular basis.*
- *You are healthy.*
- *You are between the ages of 18 and 35.*
- *You are not currently taking medication on a daily basis for anxiety or depression.*
- *You are not more than 25% overweight (if you have questions about what this means, please call for more info).*

Your participation will include a maximal exercise test and exercising 1-2 other times on a treadmill. All research will be conducted in Hill Center on the Ithaca College campus, with flexibility in scheduling. Total time involvement should not be more than 3 hours.

Appendix B

BORG RPE SCALE

6	No exertion at all
7	Extremely light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal Exertion

Appendix C

EXPERIMENTAL SESSION INSTRUCTIONS

Today you are going to be exercising at a moderate intensity. There is a short mood inventory for you to fill out before you start. Answer the questions regarding how you feel right now in time.

Next you'll warm up at a fairly easy, comfortable pace walking on the treadmill for about 5 min. Then the exercise intensity will increase to a constant, moderate pace that will last about 20 min. In order to allow you to exercise with minimal distractions, I won't be interacting with you other than to periodically ask you to rate your perceived exertion (using the same RPE scale as last visit).

After a 5 min cool-down, the exercise is over, and you'll sit quietly for 15-20 min before you fill out another mood inventory. There is a magazine for you to read during the time you sit.

Appendix D

MEDICAL HISTORY/HEALTH HABIT QUESTIONNAIRE

Name______________________________Age__________ Birthdate ______________

Address_____________________________________ Local Phone_______________

Local Physician______________________

Personal Medical/Health History -- Check if you have ever had:

Heart Disease/Stroke	_________	Lung Disease	_________
High Blood Pressure	_________	Diabetes	_________
Heart Murmur	_________	High Cholesterol	_________
Skipped or rapid heart beats or irregular rhythms	_________	Epilepsy	_________
Rheumatic Fever	_________	Injuries to joints (back, knees, ankles)	_________
Cancer	_________		

Other conditions or comments:

Family History -- Check if any of your biological relatives (parents or siblings) have or had:

Heart Disease ________ Stroke _____ Diabetes _________

High Blood Pressure _____ High Cholesterol ______

Other conditions or comments:

Present Symptoms -- Check any that you have recently had:

Chest Pain	_________	Illness, Surgery, or Hospitalization	_________
Shortness of Breath	_________	Ankle/Leg Swelling	_________
Lightheadedness	_________	Joint/Muscle Pain	_________
Heart Palpitations	_________	Allergies	_________
Loss of Consciousness	_________		

Other conditions or comments:

Appendix D (continued)
Health Habits

Smoking History

Do you smoke? (Circle one) Yes Quit Never

How much did (do) you smoke per day ? ________________

How long have you been smoking? ________________

If you have quit, when? ________________

Exercise Habits

Do you currently engage in exercise? (Circle) Yes No

If yes, What kind? ____

What intensity? (Circle) Light Moderate Hard

For what duration? ____

How often? ____

Did your past exercise habits differ from what you are doing now? (circle) Yes No

If yes, what did you do in the past? ____________________________

When was this? ____

What intensity? (Circle) Light Moderate Hard

For what duration? ____

How often? ____

Do you ever have discomfort, shortness of breath, or pain with exercise? ______

If yes, what type of exercise? ____________________________

List any medications that you are currently taking:

____

Additional Health Information Pertinent to Exercise?

Appendix E

INFORMED CONSENT FORM

Purpose of the Study:

This study will investigate whether certain psychological processes during exercise, such as thoughts and focus of attention, and specific physiological variables, such as heart rate and blood pressure, are correlated with an individual's mood state following exercise.

This study serves as a thesis project for the student investigator as partial fulfilment toward a master's degree.

Benefits to be Expected:

Subjects will gain information about their aerobic fitness level. In addition, subjects will be offered information on how to monitor the intensity component of exercise prescription.

Subject Participation:

Subjects will fill out a short health screening form called "The Physical Activity Readiness Questionnaire (PAR-Q)." Subjects will perform a graded maximal exercise test on a motorized treadmill. This test involves walking or jogging on the treadmill to the point of maximal effort or exhaustion. The exercise intensity will begin at a level you can easily maintain and will be advanced in stages of speed and incline. During this process the subject wears a mouth apparatus to measure oxygen consumption. Your heart rate will be measured at regular intervals. The test may be stopped because we observe signs of fatigue or when the subject attains test termination criteria. You may stop the test at any time because of discomfort or personal feelings of fatigue.

Subjects will also attend two independent 30 min exercise sessions in which you will jog and/or walk on a motorized treadmill at a moderate intensity. At the first jogging session you will be asked to describe the content of your thoughts during the exercise. This information will be gathered through verbal communication while you are jogging. After exercise has been terminated you will be asked to briefly summarize these thoughts in writing.

At the next session you will be asked to complete a mood inventory (that takes approximately 2 min to complete) before and after exercise. This time your heart rate and rating of perceived exertion will be assessed while you are on the treadmill. These activities will involve three separate appointments on different days. Total time commitment is estimated to be approximately 3 hours.

Subject's Initials_________

Appendix E (continued)

Risks and Discomforts:

The physical exercise involved with this study may lead to muscular aches or pains following activity. With any exercise there exists the potential risk of musculoskeletal injuries such as muscle strain. Proper warm-up and cool-down should minimize these possibilities. With the graded exercise test there does exist a slight possibility of abnormal responses in blood pressure or heart rhythm, or fainting, and in extremely rare instances, serious cardiovascular events such as heart attack or stroke. Every effort will be made to minimize these risks by following standard recommended exercise and testing guidelines and by observing the subject during the activity. An emergency plan will be in place should any serious health problems arise.

Inquiries:

Questions regarding your participation in the study, about exercise testing procedures, or about any potential risks and discomfort can be directed to Sue Fine at 277-7290 (or through campus mail addressed to S. Fine, Graduate Student, ESS, Hill Center). Dr. Fisher, the faculty advisor, can be reached at 274-3112.

Freedom to Withdraw:

Participation in this study is voluntary. You are completely free to terminate your involvement at any time with no repercussions.

Confidentiality:

Documents and data connected with your identity will not be shared with anyone who is not involved with the study. Your name will only be used on informed consent forms, the PAR-Q, and for scheduling purposes. These documents will be kept locked in the faculty advisor's office when not in possession of the investigators. Your data will never be presented to anyone in such a way that will allow you to be associated with the study.

I have read the above and understand its contents and I agree to participate in the study. I acknowledge that I am 18 years of age or older.

______________________________ ________________

Signature Date

Appendix F

AUDIOTAPE SCRIPT

Hi! Are you ready to exercise? This tape is designed to help you meet the challenge of today's workout. Its purpose is to introduce some strategies for you to use during exercise, so that your mind becomes your ally.

Even though we all have negative thoughts sometimes, I want you to consider that focusing on them is not productive. Our ideas, thoughts, and attitudes affect how we feel, so what you "think to yourself" makes a big difference. Dwelling on negative thoughts can make them seem more real or intense. For example, if you repeatedly think to yourself "I am getting tired," you are more likely to feel that way. During exercise you can fool your body into feeling better by thinking positively!!

No matter how you felt when you came in here, and no matter what you anticipated that you would feel during this exercise session, I want you to practice thinking positive thoughts right now.

Use the next few minutes of the warm-up period to really shower yourself with praise about the good job you are doing. Think as many positive thoughts as you can, especially about your ability to exercise. Convince yourself that you are enjoying the time you are spending on this treadmill. If a negative thought arises, notice what it is, but then make sure to follow it with something positive to pep yourself up with.

For those of you having a hard time coming up with positive exercise thoughts you can simply repeat to yourself over and over "I feel pretty good." Even if you don't completely believe it, DO THIS ANYWAY!

(music played until next dialogue-- approximately 3 min)

Now that the pace has increased it is especially important to practice thinking positive thoughts regarding your exercise session. If you feel some discomfort while you are exercising today, I want you to know that although these sensations may at first seem

Appendix F (continued)

unpleasant, they are normal and sometimes necessary for proper bodily functioning. Instead of disliking or worrying about new sensations, try to take them as evidence of the good workout you are getting. It is important for you to view any changes or symptoms associated with exercise as useful and as a sign of good work.

If you feel uncomfortable from time to time, monitor it, but if it is not "abnormal" or debilitating, try to positively interpret it. For example, if you are bothered by feeling sweaty, remember that this is how body temperature is regulated and that this is a good thing.

If you feel a cramp or aching somewhere, tell yourself that this confirms that you are working hard and getting a good workout. Tell yourself that you feel confident that you can relax the area where it hurts and remind yourself that it is temporary.

If you feel worried about taking this time to exercise when you should be doing something more productive, remind yourself that this is productive, that it is good for your health, and that it will probably energize you so that you work better later.

Extract something positive out of everything you feel. Feel your muscles and bones getting stronger as you work them.

Use the next few minutes to practice turning any negative thoughts into positive ones. Also, remember the importance of self talk--don't forget to tell yourself "I'm doing great." (music played until next dialogue--approximately 3 min)

In case you have drifted off at this point, and are just having thoughts float through your mind and you're not really practicing the exercises that we have discussed so far, I want to remind you again that the whole time you are exercising is a good time for you to practice thinking positive thoughts regarding your body and your exercise session. Don't let any negative thoughts bring you down during exercise. If they pop into your head, let that be a sign for you to focus on your breathing. With each breath, breathe in energy (see

Appendix F (continued)

it in any shape or form you like) and with each exhalation breathe out any negative thoughts.

Use the next few minutes to breathe any negative thoughts away and to absorb any positive energy and emotion. This can be done with either visualization or positive self-talk or both.

(music played until next dialogue--approximately 3 min)

This is just a reminder for you to stay focused in the present. Don't worry about what is to come-- in fact try not to worry about anything!

Know in your head that you can do it. If you're tired at this point, say to yourself "Everyone gets tired sometimes but if they can do it so can I." The main thing is to be confident!--pretend you're confident, even if you're not! KNOW that you can do it.

Picture yourself feeling alert and energized when this is over.

Also, remember to have a positive attitude. Actually tell yourself "I'm doing great!, I'm doing great!" Practice all the things you've heard so far.

(music played until next dialogue--approximately 3 min)

During a hard work-out maybe your legs or arms will hurt a bit or feel tired, maybe you'll have a cramp in your side or feel hot and sweaty-- or maybe none of these things will occur -- BUT, don't let any of these things stop you. Think about how Good you are doing. If you are feeling tired or bored, instead think about being successful. Remember to tell yourself to relax and that you KNOW you are going to get through it. Remember to think good thoughts! You're more than halfway done.

If you need distraction from fatigue, boredom, or aches here and there, come up with an uplifting or motivational phrase that matches your pace and rhythm. Focus on a smooth stride and repeat whatever saying you come up with. Practice making some up and just repeat them over and over to yourself in rhythm with your exercise.

Appendix F (continued)

For example, if you're feeling tense you might want to repeat the word "loose" or "relax." Shake out your hands/ shoulders/ arms if necessary and relax your jaw and facial muscles. Focus on the rhythm of your pace. The only rule is be positive and concentrate on feeling and believing the phrase that you're using. Try this out for the next few minutes. (music played until next dialogue--approximately 3 min)

When a work-out seems hard it is especially important to be confident and to convince yourself that you're in control of your mind and body.

Picture yourself feeling great when you are done-- or picture yourself crossing a finish line and see yourself feeling proud.

If you notice that your legs are tired, or your body doesn't feel good in any other way, use that as a sign to concentrate on the following statements:

"I feel good about my hard work here today."

"I enjoy my body's ability to work hard."

"My positive thoughts are going to make me feel more and more positive about this and future workouts."

Come up with any other affirmations that you like but for the next few minutes conjure up as many successful self-images as you can. Write your own success lines. Practice saying them over and over. Try this now--just a couple more minutes and you'll be done. This is your last chance during this exercise session to congratulate yourself on a job well done.

Appendix G

THOUGHT COLLECTION INSTRUCTIONS

During this exercise bout I will periodically be asking you what you are thinking about or concentrating on. Although many people are often unaware of the many thoughts that "flow" through their own mind during time spent not interacting with another person, I would like you to pay attention to this process. This does not mean that you have to concentrate about what you are thinking about but simply be aware or "notice" your thoughts as they occur and try to generally remember the content, regardless of whether they are fleeting or enduring.

I would like you to be honest about your thoughts during this session. You may have several different or unrelated thoughts or they may fall into one similar type of thought pattern. Whatever they are, be assured that this is not a psychology experiment where your thought content will be analyzed to figure out what kind of person you are. The study is not interested in connecting thoughts to a person type. There is no "normal" or expected way to think, so do not be the slightest bit concerned about trying to say what you think is expected of you. You will not be evaluated at all in terms of your thought content. Generally, the study is trying to collect the scope of thoughts that occur during exercise, so any kind of thought is fair game.

Your thoughts may fall into one of the following domains. Examples of specific lines of thought that fit into each category follow:

-Thoughts related to physical sensations or bodily responses (or basically, how you physically feel in terms of performing the exercise):

<u>Examples:</u> "My legs hurt."
"I feel pretty good."
"I feel so out of breath."
"My lungs are burning."
"I feel tired or exhausted."
"My heart rate seems too fast"
"Why am I sweating so much?"

Appendix G (continued)

Thoughts related to review of the day's events, past events, or future plans:
<u>Examples:</u> "I wonder how I did on that exam yesterday."
"I can't wait to see so-and-so later."
"I wonder why so-and-so seemed mad at me before."
"Making lists of things to remember or things I have to do."

Thoughts related to how you look or being concerned about what others are thinking about you:
<u>Examples:</u> "I wonder if I look ...good, or thin, or fat, or clumsy, or whatever."
"What if I can't finish, what will they think?"

Thoughts related to your abilities or fitness level:
<u>Examples:</u> "I seem to be doing this OK, I must not be in that bad of shape."
"I must be really unfit if I am having such a hard time."

Thoughts related to the surroundings:
<u>Examples:</u> "It's too... hot, or cold, or stuffy in here."
"This room is so small."
"This treadmill makes a lot of noise."

These are just some areas that your thoughts may fall into. Perhaps you will think about the time, friends, family, or relationships, hobbies, music, or worry about something not listed here.

Whatever you think about please do your best to honestly share it because this is important to the purpose and outcome of this study. *Remember, you will not be judged or evaluated on your thought content.*

The information you provide regarding your thoughts will not be connected to your name (a subject number will be used) and will be kept confidential.

Appendix H
THOUGHT COLLECTION FORM

Subject # _________ Date _________

Please list any thoughts that occurred to you during the exercise session that you just completed. Start by listing the thoughts that stuck in your head the longest (that you spent the most time thinking about) and end with the thoughts that were more fleeting. Another way of doing this is to make a list of all the thoughts you can remember and label them as primary or secondary in importance. Grammar or writing style are not important!! --as long as I can read it!

Appendix I

COMPILATION OF THOUGHTS DURING EXERCISE

"This is boring."

"My skin is starting to itch from sweat."

"My fingers feel swollen."

"My legs are sore. "

"My skin is burning. "

"My feet are hot. "

"My arches hurt. "

"My feet feel heavy."

"There is a pain in my collarbone. "

"I feel a cramp coming but it's under control. "

"I'm thinking about a paper I have to write. "

"Looking at poster on the wall and wishing I was there. "

"My cramp hurts a lot. "

"My hair is bothering me--is falling in my face. "

"I hate cramps when I exercise. Why do I get them? "

"I sweat more than the average person, it's disgusting. "

" I hope I'm not screwing up the results. "

"Am I doing this right?"

"I hope I don't fail my class. "

"I hate shin splints I have them right now. "

"How much more time do I have?"

"I am looking at things on the wall. "

"My hair is annoying me. "

"I am looking at the HR monitor. "

Appendix I (continued)

“I'm starting to sweat like crazy. “

“I'm so tired already. “

“Wondering what HR is right now. “

“The treadmill seems harder than running outside. “

“I'm tired. “

“I'm counting blocks on the wall. “

“Wondering when the time is up. “

“Feel hot and sweaty. “

“I'm thinking it wouldn't be this hard if I were in better shape. “

“I am looking at picture on wall and things in the room. Trying not to think about how much longer. My body feels fine. “

“I am looking at the picture-trying to imagine I'm there. “

“My achilles are getting sore. “

“My knee hurts a little. My ankle hurts a little.”

“I am getting sweating and hot in here. I am trying to think happy thoughts.”

“My feet feel like lead.”

“My shins are burning.”

“I am thinking about what I'm going to do later.”

“I would like to jump in the lake in the poster.”

Appendix J

RAW DATA

Subject #	9	13	14	15	18	22	25	26	1	3	10	12	19	21	24	29	2	4	11	16	17	20	23	28
Treatment	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
Gender	2	2	2	2	1	1	1	1	2	2	2	2	2	2	2	2	2	2	1	2	2	2	1	2
Age	37	19	26	21	18	19	23	24	23	21	22	20	18	18	20	30	21	21	31	21	28	20	21	32
Height (in)	68	63	61	60	71	68	73	74	65	60	60	63	67	64	67	64	60	66	69	60	64	64	73	64
Weight (lbs)	135	139	139	141	145	168	174	180	137	101	127	142	135	139	143	148	133	146	149	134	115	130	222	130
Vo2 Max	32.55	39.36	39.18	38.07	48.9	52.2	50.93	50.87	37.28	36.1	34.47	35.48	40.9	44.74	40.81	36.92	36.4	44.64	53.59	36.98	40.58	40.35	43.13	37.93
Max HR	179	195	206	196	197	185	197	192	201	197	174	200	189	212	203	177	192	201	187	184	201	192	194	180
Refresh Pre	1	1	0	2	0	3	1	0	2	1	0	1	1	2	2	0	0	2	0	0	0	1	1	1
Calm Pre	1	3	2	3	3	3	2	3	2	2	2	3	4	3	2	2	1	3	2	0	1	3	3	1
Fatigue Pre	2	2	2	1	2	2	1	1	0	2	2	0	1	1	2	1	1	1	1	3	4	1	1	3
Enthuse Pre	2	2	1	1	1	3	1	1	2	3	1	1	0	2	2	0	0	4	1	0	0	2	0	2
Relax Pre	1	1	2	3	3	4	2	2	1	2	3	3	4	3	2	2	1	3	2	0	2	3	3	1
EnergeticPre	2	0	0	1	0	2	2	1	2	2	1	2	0	3	2	0	1	3	2	0	0	2	1	3
Happy Pre	1	1	0	2	2	3	2	2	2	4	3	1	2	3	3	1	0	3	3	1	1	2	3	1
Tired Pre	2	3	2	2	3	1	1	2	2	2	2	0	0	1	2	1	1	0	1	3	4	1	1	2
Revived Pre	2	0	0	2	0	3	0	0	1	2	1	1	1	1	1	0	0	2	1	0	1	1.5	1	1
Peaceful Pre	1	1	1	1	4	3	1	3	2	1	3	3	4	3	2	0	1	2	2	1	2	2	4	1
Wornout Pre	3	3	2	1	3	1	1	1	1	3	2	0	0	0	2	0	3	1	1	2	3	1	1	2
Upbeat Pre	1	1	1	2	2	2	2	0	3	3	1	2	0	2	2	0	0	2	2	0	1	1	1	1
Refresh Post	2	2	2	3	3	1	2	2	2	2	3	4	3	2	3	2	2	4	0	1	0	2	2	3
Calm Post	2	3	3	4	3	3	3	4	2	3	3	2	3	3	3	3	2	3	3	2	3	3	4	3
Fatigue Post	2	2	1	0	1	2	1	2	0	1	2	1	1	1	1	0	1	1	2	1	4	1	1	0
Enthuse Post	1	2	3	3	3	2	1	2	2	2	2	2	2	3	3	0	1	3	2	1	1	2	2	2
Relax Post	1	3	3	4	3	4	2	4	3	3	3	3	1	3	2	4	2	3	3	3	2	2	4	3
Energetic Post	2	1	2	3	3	2	2	1	3	3	2	2	2	3	3	1	1	3	1	0	0	2	1	2
Happy Post	2	3	2	3	3	3	2	3	2	3	3	2	3	3	3	3	1	3	3	2	1	2	3	2
Tired Post	2	3	2	0	1	3	1	3	1	2	2	1	1	1	1	0	2	1	2	1	4	0	2	0
Revived Post	2	1	2	3	2	2	2	1	3	3	3	3	3	3	2	3	1	3	1	1	2	2	1	2
Peaceful Post	2	2	3	3	3	4	2	3	3	1	3	2	3	3	2	2	2	3	3	3	2	2	4	2
Wornout Post	1	3	2	0	2	2	0	1	1	1	3	1	0	0	0	0	1	1	2	0	4	1	1	0
Upbeat Post	2	1	3	3	3	1	2	0	3	4	3	2	2	2	3	1	0	3	2	1	0	2	1	2
HR 10 min	140	172	174	161	170	148	162	155	136	142	146	170	163	182	177	134	136	160	138	163	157	171	153	119
HR 15 min	144	174	184	171	176	152	166	162	145	143	146	180	167	190	185	137	140	170	143	168	162	176	159	121
HR 20 min	145	180	187	168	174	156	164	159	145	147	150	186	172	188	186	138	142	175	139	165	165	177	163	122
HR 25 min	150	184	187	170	175	156	168	163	145	149	139	186	177	191	190	145	152	182	140	170	167	179	165	128
RPE 10 min	12	12	11.5	11.5	9	11	10.5	13	11	11	12	13	12	10	11	12	12	11.5	12	13	11	13	12	10
RPE 15 min	12	14	13	13	15	13	11	13	12.5	12	15	13	12	12	12	12	13	13	13	14	13	14	13.5	11
RPE 20 min	12	16	13.5	13	16	15	11.5	14	13	13	17	16	12.5	13	12	13	15	14	14	15	15	16	13	12
RPE 25 min	12	16	15	13	16	16	12	14.5	13.5	13	15	15	13	14	13	13	16	15	15	15.5	17	16	12	14

Note. Treatment: 1 = CS, 2 = M, 3 = Control; Gender: 1= Male, 2= Female.

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