EXERCISE AND CLINICAL DEPRESSION: EXAMINING PSYCHOLOGICAL MECHANISMS

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ABSTRACT

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Chronic exercise interventions have been shown to be associated with a reduction in the symptoms of clinical depression (Craft & Landers, 1998; North, McCullagh, & Tran, 1990). However, the mechanisms for the antidepressant effects of exercise remain poorly understood. This study examined two previously proposed psychological mechanisms: self-efficacy and distraction. Further, the relationship between transient mood elevation following acute bouts of exercise and symptoms of depression was explored. Nineteen clinically depressed women, aged 43.21 (SD = 13.23) years, served as study participants. Dependent measures were severity of depression, coping self-efficacy, and response style (i.e. rumination and distraction). Participants chose to participate in either the control group or a 9-week exercise intervention group. Dependent variables were measured at study entry, 3, 6, and 9 weeks later. Repeated measures multivariate analysis of variance indicated that exercise was associated with a reduction in symptoms of depression, an enhancement in coping self-efficacy, and a reduction in the tendency to use a ruminative response style. Regression analyses showed that coping self-efficacy had a significant negative relationship with depression among exercise group participants. Mood data revealed that depressed women experienced mood elevation following acute bouts of exercise and that this enhanced mood lasted for at least 15 min following exercise. Data did not support the prediction of

an association between transient mood changes following acute exercise and severity of depression.

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CHAPTER ONE

Introduction

Clinical depression affects roughly 9.5% of the United States (U.S.) adult population (National Institutes of Mental Health, 2001). Depression is characterized by a variety of symptoms including feelings of sadness, irritability, changes in sleep and appetite, feelings of worthlessness, loss of pleasure from enjoyable activities, and psychomotor retardation (American Psychiatric Association, 1994). Depression is twice as prevalent in females as males and the risk of a recurrence can be as high as 50-90% (Preskorn, 1999; Stahl, 1996). This chronic illness is very costly to the U.S. health care system and each year over 40 billion dollars are spent on lost productivity and medical treatment related to depression (Zerihun, 2001).

Traditional treatments for clinical depression have primarily included psychotherapy and pharmacological interventions (Johnson & Miller, 1994; Preskorn, 1999). Unfortunately, these therapies are often ineffective and, for some, also have extremely adverse side effects (Byrne & Byrne, 1993; Leith, 1994; Mutrie, 2000; Raglin, 1990; Stahl, 1996). Furthermore, health care changes in the U.S. have led to time constraints for therapy and limits in payment for mental health services (Mirin & Sederer, 1994). Therefore, practitioners and researchers have begun to examine possible alternatives in the treatment of this disorder.

Exercise has been proposed as one plausible adjunct or alternative to the traditional treatments for depression. The first studies on exercise and depression were cross-sectional, comparing the physical activity and physical capacity levels of depressed and non-depressed individuals (Martinsen, Strand, Paulsson, & Kaggesstad, 1989;

Morgan, 1969, 1970). Exercise intervention studies followed, examining the efficacy of exercise in alleviating depression (Brown et al., 1992; Dimeo, Baurer, Varahm, Proest, & Halter, 2001; Doyne, Chambless, & Beutler, 1983; McNeil, LeBlanc & Joyner, 1991; Veale et al., 1992). Researchers have also investigated whether certain types of exercise are more effective in alleviating depression than others (Doyne et al., 1987; Martinsen, Hoffart, & Solberg, 1989; Sing, Clements, & Fiatarone, 1997). Exercise has been compared to more traditional treatments such as psychotherapy, behavioral modification, and medication (Babyak et al., 2000; Blumenthal et al., 1999; Greist et al., 1979; Kleine et al., 1985). Meta-analytic studies also suggest that chronic exercise is effective in alleviating symptoms of depression, that exercise is as effective as most traditional treatments, that exercise appears effective across genders, and that mode, frequency, and intensity of exercise do not appear to moderate the effect (Craft & Landers, 1998; North, McCullagh, & Tran, 1990). While the research is relatively clear that chronic exercise helps alleviate symptoms of depression our knowledge remains limited regarding the mechanisms by which exercise exerts its effect.

Mechanisms for the Antidepressant Effects of Exercise

The overwhelming research support for exercise as an effective means to alleviate depression has led some researchers to examine potential causal links between exercise and depression. While there are researchers who contend that exercise causes a reduction in depression (Mutrie, 2000), others argue that more information is needed before a causal association can be confirmed (Landers & Arent, 2001). Research to date has not extensively examined the plausible mechanisms suggested in the literature. Therefore, it appears that a better understanding of the mechanisms behind the antidepressant effects

of exercise would not only provide additional insight into a possible causal association, but should also be helpful in the future use of exercise as an adjunct therapy in the treatment of depression. Studies are needed to examine the potential physiological and psychological mechanisms (Dunn, Trivedi, & O'Neil, 2001; Fox, 1999; Landers & Arent, 2001; Leith, 1994). Two psychological explanations that have received attention in the literature and warrant further examination are self-efficacy theory and the concept of distraction.

Self-Efficacy

Self-efficacy, or the level of confidence one feels to meet the challenge at hand, has been proposed as one mechanism by which exercise may help reduce symptoms of clinical depression. Self-efficacy refers to the belief that one possesses the necessary skills to complete a task as well as the confidence that the task can actually be completed with the desired outcome obtained. Efficacy beliefs direct choice of behavior, goals that are chosen, persistence at a task, motivation and effort, expectations of success, and how one responds affectively (Bandura, 1997). Bandura (1997) contends that healthy individuals are able to regulate goal directed behaviors and are also able to use regulatory strategies for their thoughts, feelings, and emotions. This idea of self-regulation has led to the investigation of the concept of coping self-efficacy. People's beliefs about their ability to control a stressful situation and regulate their response to the situation is a primary determinant of how they will respond. A low sense of self-control or coping efficacy can cause people to approach situations anxiously and with little confidence to obtain the desired outcome (Bandura, 1997).

Bandura (1997), utilizing self-efficacy theory, describes how the low sense of efficacy of those with depression often leads to negative self-evaluations, negative ruminations, and faulty styles of thinking. Further, depressed people often blame themselves for negative life events and this negative explanatory style can worsen and prolong their depression (Peterson & Seligman, 1984). Individuals with low efficacy to stop or restructure negative thoughts have also been shown to have higher levels of depression (Kavanagh & Wilson, 1989).

Several different factors influence the development of efficacy beliefs (Bandura, 1997). The best source of efficacy information appears to come from mastery experiences. When an individual can repeatedly derive a course of action, follow a plan, and meet the desired outcome in the face of changing situations and obstacles then he or she is likely to feel highly efficacious. On the contrary, repeated failures at such attempts to navigate through life can lead to decreased feelings of self-efficacy.

Exercise may provide an effective mode to enhance efficacy beliefs based on its ability to provide a meaningful mastery experience. According to Bandura (1997), in order for an intervention to lead to enhanced coping self-efficacy it must teach the individual how to self-monitor behaviors, set goals, and utilize social support to maintain the desired behaviors. Learning how to monitor exercise behaviors, set short and long term exercise goals, and positive support from the exercise instructor and significant others can all contribute to feelings of mastery. Therefore, it is possible that the antidepressant properties of exercise are related to enhanced feelings of efficacy that result from this mastery experience.

Research examining the relationship between physical activity and self-efficacy has predominately focused on the enhancement of physical self-efficacy and efficacy to regulate exercise behaviors (Beniamini, Rubenstein, Zaichkowksy, & Crim, 1997; Ewart, Stewart, Gillilan, & Kelemen, 1986; McAuley, 1992; McAuley & Courneya, 1992; McAuley, Lox, & Duncan, 1993). The relationship between exercise and self-efficacy in depressed patients has not been studied extensively and findings have been equivocal (Brown, Welsh, Labbe, Vitulli, & Kulkarni, 1992; Singh, Clements, & Fiatarone, 1997). Furthermore, generalized feelings of efficacy rather than coping self-efficacy have been the focus of the research to date. Enhanced feelings of coping have been associated with exercise participation in anxious adults (Steptoe, Edwards, Moses, & Mathews, 1989), however, as mentioned previously, this relationship has not been examined with the clinically depressed. Therefore, the role that exercise can play in augmenting the coping self-efficacy of depressed patients needs further investigation.

Distraction

The concept of distraction has also been promoted as a possible explanation for the antidepressant effects of exercise. Some researchers (Bahrke & Morgan, 1978; Gleser & Mendleberg, 1990; Johnsgard, 1989; Leith, 1994) have suggested that physical activity serves as a distraction from worries, anxiety, and depressing thoughts. A theory of depression that is conceptually related is the response styles theory (Nolen-Hoeksema, 1991). This theory discusses two different dispositional ways in which individuals typically respond to feelings of depression and how these differing responses can affect the severity and length of a depressive episode. Rumination is a response style that involves the tendency to passively and repeatedly focus on one's negative feelings and

the consequences of those feelings. Distraction refers to a response style in which the individual busies herself in an engaging activity (i.e. a hobby, work) in an attempt to focus on something other than the depressed mood.

Rumination is thought to have a negative influence on the course of depression. Rumination may lead to negative thoughts and attributions about the self, past, present, and future which can contribute to a continued depressed mood (Lyubomirsky & Nolen-Hoeksema, 1995). Individuals who focus on their negative thoughts rather than engage in activities to solve their problems are at risk for prolonged bouts of depression (Nolen-Hoeksema, Parker, & Larson, 1994). Those who ruminate about their depression may not engage in behaviors that provide the opportunity for positive reinforcement and an enhanced sense of control (Lyubomirsky & Nolen-Hoeksema, 1993). Without such opportunities, the depressed individual may experience feelings of helplessness, negative evaluations of self, lowered expectancies for the future, and a lack of motivation to meet new challenges (Nolen-Hoeksema, 1991). Research related to response styles theory has shown that women spend more time ruminating than men, that men tend to use distraction more than women, and that individuals who ruminate generally have more severe and longer lasting episodes of depression than those who use distraction as a response style (Just & Alloy, 1997; Morrow & Nolen-Hoeksema, 1990; Nolen-Hoeksema & Morrow, 1991; Nolen-Hoeksema, et al., 1993). Therefore, based on the current research, a distraction response style appears to be associated with a more positive outcome for those suffering from depression (Nolen-Hoeksema, 1991, 1998).

Nolen-Hoeksema (1991) cautions that not all activities are distracting. An effective distracting activity engages the individual and has a high probability of

providing opportunities for positive reinforcement (Nolen-Hoeksema, 1991). The very nature of exercise makes it a potentially distracting activity worthy of investigation. When working out, people are often focused on training goals or attending to somatic changes such as their breathing, heart rate, fatigue, or sore muscles (Leith, 1994). Furthermore, exercise offers the opportunity for positive reinforcement as exercise goals are met, daily workouts become less painful and fatiguing, and significant others reward the individual for taking a proactive role in the management of her symptoms. Therefore, the antidepressant effects of exercise may result from the ability of exercise to provide periodic distraction from negative thoughts and feelings of depression. As mentioned previously, this temporary attenuation of depressed mood may allow for more effective problem-solving behaviors.

Response styles theory has not yet been tested with depressed participants who engage in an exercise program as a distracting activity. Exercise has been compared to other distracting activities such as relaxation, assertiveness training, health education, and social contact (Doyne et al., 1983; Klein et al., 1985; McNeil, LeBlanc, & Joyner, 1991; Singh, Clements, & Fiatarone, 1997). Results of these studies have been inconclusive with exercise being more effective than some activities and similar to others in its ability to aid in the reduction of depression. This line of research, however, has only examined the overall effect of these activities on symptoms of depression. It is proposed in the present dissertation that an exercise program may lead to an alteration in response style. Exercising individuals may spend less time in rumination and, instead, engage in distracting activities as a means to elevate their mood.

Mood Elevation Following Acute Bouts of Exercise

While it has not been formally proposed as a potential mechanism for the antidepressant effects of exercise, it is conceivable that transient mood elevation following repeated acute bouts of exercise might be associated with reductions in the symptoms of clinical depression. Although exercise has been shown to be effective in alleviating the symptoms of more severe mood disorders such as anxiety and depression (Craft & Landers, 1998; Landers & Petruzzello, 1994), there is also a popular notion that exercise can have a positive influence on normal variations in mood as well. The relationship of transient mood enhancement with clinical depression has not been extensively examined in the exercise science literature, but the ability of exercise to enhance mood in the general population has long been a popular area of investigation.

Researchers were initially interested in the ability of exercise to improve negative mood states. Findings suggest that exercise can reduce negative aspects of mood (Berger & Owen, 1988; Fremont & Craighead, 1987; Markoulakis & Zervas, 1993; McGowan, Talton, & Thompson, 1996; McGowan & Pierce, 1991; Yeung, 1996). Further, exercise can enhance the positive aspects of mood as well (Arent, Landers, & Etnier, 2001; McIntyre, Watson, & Cunningham, 1990; Petruzzello, Jones, & Tate, 1997; Steptoe & Cox, 1988; Tate & Petruzzello, 1995).

Several variables such as gender, type of exercise, duration, intensity, and frequency of exercise have been examined as potential moderators of the effect of exercise on mood. Exercise can elevate mood for both males and females but the effects may be larger for women (Berger, Owen, Motl, & Parks, 1998; Roth, 1989; Stephens, 1988). Stephens (1988) suggests that this relationship may result from the fact that

women are generally more sedentary then men and therefore, likely have more to gain from the exercise bout. Many different types of exercise have been associated with enhanced mood (Berger & Owen, 1993; Blumenthal et al., 1982; Fremont & Craighead, 1987; Hartz, Wallace, & Cayton, 1982; Maroulakis & Zervas, 1993; McGowan et al., 1993; McGowan & Pierce, 1991; McGowan et al., 1996). As for the optimal duration of the exercise bout, the literature remains unclear (Berger & Owen, 1983; Flory & Holmes, 1991; Hobson & Rejeski, 1993; Thayer et al., 1993). The current general recommendations are 20-30 min bouts of exercise (Hansen, Stevens, & Coast, 2001). Although the findings have been somewhat inconsistent, research suggests that moderate intensity exercise is most beneficial for improving mood (Berger & Owen, 1998; Hardy & Rejeski, 1989; McGowan et al., 1996; Moses et al., 1989; Parfitt, Eston, & Connolly, 1996; Steptoe & Cox, 1988). Finally, the optimal frequency of exercise also remains unknown as mood enhancement has been associated with as few as one bout of exercise per week (Hartz, et al., 1982; Roth, 1989; Steptoe, Kearsley, & Walters, 1993; Wilson et al., 1980).

Much of the aforementioned research has examined the relationship between chronic exercise and mood. Acute exercise, however, has also been studied and the positive effects of acute exercise on mood have been noted at 15 min, 30 min, and even 24 hr following the exercise bout (Dyer & Crouch, 1988; Hansen et al., 2001; Maroulakis & Zervas, 1993; McMillan et al., 1993; Steptoe et al., 1993). Little is known about the mood enhancing effects of acute exercise in individuals suffering from mental health problems. Two studies were located that examined the relationship between exercise and mood in depressed individuals involved in chronic exercise programs (Fremont &

Craighead, 1987; Hartz et al., 1982). The findings of these two studies were inconclusive with some participants experiencing enhanced mood and others failing to benefit from the exercise intervention. Unfortunately, no studies were located that examined the effects of an acute bout of exercise on mood in clinically depressed individuals.

The opponent process theory (Solomon, 1980) can provide a theoretical foundation on which one could make predictions regarding the mood enhancing effects of acute exercise. This theory states that as an individual engages in an arousing activity there are two opposing processes that are occurring simultaneously. The predominate response is termed the "A" state. This is the stimulating or arousing response and is initially quite strong and weakens across time. The opposing response is termed the "B" state. This response is in opposition to the "A" state and attempts to return the body to homeostasis. The "B" state is initially weak but strengthens across time. With continued exposure to the arousing activity, the "A" state weakens and the "B" state strengthens. With exercise, we could predict that when first beginning an exercise program the "A" state is initially unpleasant. For example, the individual may feel fatigued, have sore muscles, feel short of breath, etc. The "B" state, conversely, is in opposition to the negative feelings of the "A" state, is shorter lasting initially, and is generally pleasant (i.e. relaxation, stress reduction). Over time, we would expect that the "A" state would shorten, leading to less negative feelings associated with exercise. The "B" state should lengthen, leading to enhanced and longer lasting feelings of improved mood.

Only one study was located that examined this theory within the confines of acute exercise (Petruzzello et al., 1991). The authors found partial support for the theory in that post exercise affective states were more positive than affective states during exercise.

However, prior exposure to exercise did not moderate the affect as anticipated. This theory should be investigated further with those suffering from clinical depression. Researchers and clinicians need to understand at what point in a chronic exercise intervention individuals may begin to feel mood elevation after each acute bout of exercise and how long such mood elevation is likely to last.

Therefore, the purpose of this study was to explore two research questions. First, two previously proposed mechanisms for the antidepressant effects of exercise, self-efficacy and distraction, were examined. The relationships between self-efficacy, response style (rumination and distraction), exercise, and clinical depression were studied. The following hypotheses were proposed:

1. A chronic exercise intervention is associated with a reduction in the symptoms of clinical depression.
2. Participants in an exercise training intervention will report increased levels of coping self-efficacy.
3. Depressed individuals who engage in a chronic exercise intervention will report a reduced tendency to ruminate on their depression and an increased use of distraction across the 9-week intervention.
4. Obtained levels of coping self-efficacy, rumination, and distraction will be related to current levels of depression among exercise group participants.

The second research question was exploratory in nature. I examined whether or not depressed participants experienced enhanced mood following acute exercise bouts. Furthermore, the length of mood enhancement following acute exercise bouts, and the

potential relationship between this transient elevation in mood and symptoms of depression was explored.

CHAPTER TWO

Review of the Literature

Clinical depression affects millions of Americans each year. It is estimated that 18 million adults or roughly 9.5% of the United States (U.S.) population aged 18 years and older will experience a depressive episode each year (National Institutes of Mental Health, 2001). Depression is twice as prevalent in females as males and the risk of a recurrence can be as high as 50-90% (Preskorn, 1999; Stahl, 1996). This disease is also very costly to the U.S. economic system. Each year, over 40 billion dollars is spent on lost productivity and medical treatment related to depression (Zerihun, 2001). A recent study examining trends in the treatment of depression has shown that between the years of 1987 and 1997 the rate of outpatient treatment for depression in the U.S. tripled and that health care costs related to this illness continued to rise (Olfson, Marcus, Druss, Elinson, Tanielian, & Pincus, 2002). With depression ranked as the fourth leading cause of disability worldwide (Murray & Lopez, 1996), it appears that this disorder will continue to effect millions of individuals and economically drain the health care system.

Traditional treatments for clinical depression have primarily included psychotherapy and pharmacological interventions (Johnson & Miller, 1994; Preskorn, 1999). Unfortunately, these therapies are often ineffective and, for some, also have extremely adverse side effects (Byrne & Byrne, 1993; Leith, 1994). For example, psychotherapy is often very timely and costly (Mutrie, 2000). Pharmacological interventions can pose a variety of negative side effects including hypertension, dizziness, dry mouth, blurred vision, sedation, weight gain, agitation, and sexual dysfunction (Leith, 1994; Raglin, 1990; Stahl, 1996). Furthermore, health care changes

in the U.S. have led to time constraints for therapy and limits in payment for mental health services (Mirin & Sederer, 1994). Therefore, practitioners and researchers are investigating possible alternatives in the treatment of this disorder.

Exercise has been proposed as one plausible adjunct or alternative to the traditional treatments for depression. There have been numerous research studies that have examined the relationship of exercise with clinical depression. For example, researchers have conducted cross-sectional studies comparing the physical activity and physical capacity levels of depressed and non-depressed individuals (Martinsen, Medhus, & Sandvik, 1985; Martinsen, Strand, Paulsson, & Kaggesstad, 1989; Morgan, 1969, 1970). Results indicated that depressed individuals were more physically sedentary than the non-depressed, that physical work capacity (PWC) was lower in depressed individuals, and that the PWC of depressed adults was only 80-90% of predicted norm values. Further, PWC demonstrated a significant negative correlation with severity of depression. While these early studies did not address the directional nature of the relationship between physical capacity and depression, researchers have continued to investigate the ways in which physical activity is related to depression.

The efficacy of exercise to alleviate depression has also been examined. The majority of studies have shown that exercise is related to a reduction in depression and that exercise appears effective for both males and females (Brown, et al., 1992; Dimeo, Baurer, Varahm, Proest, & Halter, 2001; Doyne, Chambless, & Beutler, 1983; McNeil, LeBlanc, & Joyner, 1991; Veale et al., 1992). The types of exercise utilized with depressed patients have also been studied in an attempt to determine if certain kinds of exercise are more effective in alleviating depression (Doyne et al., 1987; Martinsen,

Hoffart, & Solberg, 1989; Sing, Clements, & Fiatarone, 1997). Most often, aerobic activities (such as running) have been compared to strength training activities, which are primarily non-aerobic in nature. Both forms of exercise have been shown to be beneficial. Finally, researchers have compared exercise to more traditional treatments such as psychotherapy, behavioral modification, and medication (Babyak et al., 2000; Blumenthal et al., 1999; Greist et al., 1979; Kleine et al., 1985). The results of these studies are very encouraging and indicate that exercise is as effective as most traditional therapies such as psychotherapy and behavioral interventions. The recent work by Blumenthal and colleagues (Babyak et al., 2000; Blumenthal et al., 1999) suggests that exercise may be as effective as some antidepressant medications. In their studies, medication worked more quickly to reduce depression but exercise was as effective as medication by the end of the 16-week exercise program.

While the vast majority of the evidence from these studies provides support for the antidepressant effects of chronic exercise, the research in this area has been criticized for suffering from a variety of methodological flaws. (Byrne & Byrne, 1993; Gleser & Mendelberg, 1990; Martinsen, 1990, 1993, 1994). For example, studies have failed to utilize random assignment and control groups and have used very small sample sizes (Blue, 1979; Doyne, Chambless, & Beutler, 1983; Hartz, Wallace, & Clayton, 1982). Further, participants have often been college students with depressed affect or post myocardial infarction patients, rather than individuals suffering from diagnosed clinical depression (Jasnowski, Holmes, & Banks, 1988; Kavanaugh, Shephard, Tuck, & Qureshi, 1977; McCann & Holmes, 1984; Sharp & Reilley, 1975; Stern & Cleary, 1981). Finally, many of the studies have failed to report exercise protocols or have done a poor job in

actually achieving fitness gains with aerobic activities (Brown et al., 1992; Doyne et al., 1987; McNeil, LeBlanc, & Joyner, 1991).

Therefore, in an attempt to understand the overall pattern of the research findings and to investigate variables that may potentially moderate the effect of exercise on depression, researchers have synthesized the results of the primary studies in this area (Craft & Landers, 1998; North, McCullagh, & Tran, 1990). Results of these meta-analyses indicate that chronic exercise is effective in alleviating symptoms of depression. In the Craft and Landers (1998) study, the overall effect size was reported as -0.72. North and colleagues (1990) reported a smaller overall effect size of -0.53, but when considering only studies that used clinical samples the effect increased to -0.94. Interestingly, these studies found that duration, intensity, frequency, and mode of exercise did not moderate the relationship between exercise and depression. Length of exercise program did moderate the effect, with interventions of 9 weeks or longer being most effective. Other variables such as gender, age, and initial severity of depression were also considered. Findings were very encouraging with exercise effective for both males and females of all ages as well as those who are initially more severely depressed. Therefore, in light of this additional meta-analytic support, researchers have begun to recommend that depressed individuals should adopt physically active lifestyles to help manage their symptoms (Craft & Landers, 1998; Fox, 1999; Mutrie, 2000).

While the research is relatively clear that chronic exercise helps alleviate symptoms of depression, the mechanisms for the antidepressant effects of exercise remain unknown. Several physiological and psychological mechanisms have been

proposed for the antidepressant effects of exercise. However, our knowledge remains limited regarding the ways in which exercise reduces symptoms of depression.

Mechanisms for the Antidepressant Effects of Exercise

The overwhelming support for exercise as an effective means to alleviate depression has led some researchers to examine potential causal links between exercise and depression. For example, Mutrie (2000) suggests that exercise is not only related to reductions in depression but that it causes a reduction in depression. Mutrie bases her determination of this causal link on epidemiological principles (Hill, 1965) such as strength of association, consistency, temporal sequence, biological plausibility, and experimental evidence. Landers and Arent (2001) however, argue that in order for a causal association to be met, the following must also be demonstrated: a dose-response relationship, coherence, and specificity. Landers and Arent (2001) suggest that there is little evidence for either a dose-response relationship or specificity of effect. As for coherence, ("the idea that possible mechanisms do not conflict with what is known about the natural history and biology of the disease," p. 755), the research to date has not extensively examined the plausible mechanisms suggested in the literature. Therefore, it appears that a better understanding of the mechanisms behind the antidepressant effects of exercise would not only provide additional insight into a possible causal association, but should also be helpful in the future use of exercise as an adjunct therapy. Until researchers and clinicians understand how exercise leads to a reduction in depression it will be difficult to further our attempts to effectively utilize exercise with clinically depressed patients.

Several credible physiological and psychological mechanisms have been described such as the thermogenic hypothesis, the endorphin hypothesis, the monoamine hypothesis, the distraction hypothesis, and the enhancement of self-esteem and self-efficacy (Bandura, 1997; Dishman, 1997; Gleser & Mendelberg, 1990; Leith, 1994; Martinsen, 1990; Ransford, 1982; Simons, McGowan, Epstein, Kupfer, & Robertson, 1985). However, there is little research evidence to either support or refute most of these theories. Therefore, studies are needed that examine these potential physiological and psychological mechanisms (Dunn, Trivedi, & O'Neil, 2001; Fox, 1999; Landers & Arent, 2001; Leith, 1994).

Physiological Mechanisms

The three physiological mechanisms mentioned above (i.e. thermogenic, endorphin, and monoamine hypotheses) have been the primary physiological explanations proposed for the antidepressant effects of exercise. The thermogenic hypothesis suggests that a rise in body core temperature following exercise is responsible for the reduction in symptoms of depression. DeVries (1981) explains that increases in temperature of specific brain regions, such as the brain stem, can lead to an overall feeling of relaxation and reductions in muscular tension. While this idea of increased body temperature has been proposed as a mechanism in the relationship between exercise and depression, the research conducted on the thermogenic hypothesis has only examined the effect of exercise on feelings of anxiety (DeVries, 1968; Morgan, 1988; Raglin & Morgan, 1985).

The endorphin hypothesis predicts that exercise has a positive effect on depression due to an increased release of beta-endorphins following exercise.

Endorphins are related to a positive mood and an overall enhanced sense of well-being. This line of research has not been without criticism. The debate remains as to whether plasma endorphins reflect endorphin activity in the brain. However, some (Johnsgard, 1989; Morgan, 1985) have argued that even if peripheral endorphin levels are not reflective of brain chemistry they could still be associated with a change in mood or feelings of depression. Several studies have shown increases in plasma endorphins following acute and chronic exercise (e.g., Bortz, Angwin, & Mefford, 1981; Carr et al., 1981; Farrell, Gates, & Maksud, 1982), however, it remains unclear if these elevations in plasma endorphins are directly linked to a reduction in depression.

The monoamine hypothesis appears to be the most promising of the proposed physiological mechanisms. This hypothesis predicts that exercise leads to an increase in brain neurotransmitters (i.e. serotonin, dopamine, norepinephrine) that are related to symptoms of depression. These neurotransmitters increase in plasma and urine following exercise (Ebert, Post, & Goodwin, 1972; Post, Kotin, Goodwin, & Gordin, 1973; Tang, Stancer, Takahashi, Shephard, & Warsh, 1981). However, whether exercise leads to an increase in neurotransmitters in the brain remains unknown. Animal studies suggest that exercise increases chemicals such as serotonin and norepinephrine in various brain regions (Dishman, 1997; Dunn, Reigle, Youngstedt, Armstrong, & Dishman, 1996; Jacobs, 1994). However, in humans this has not been studied.

Therefore, while several physiological mechanisms remain plausible, methodological difficulties have prevented this line of research from advancing in humans. Martinsen (1987) discusses how testing biochemical hypotheses are often difficult in humans due to the invasive procedures necessary to obtain samples (i.e. blood

samples, cerebrospinal fluid samples). Further, biochemical samples obtained from blood or other body fluids may not directly reflect the activity of these compounds in the brain (Dishman, 1997). Hopefully, with the advent of new neuroimaging techniques, future researchers can examine whether exercise leads to the neurochemical changes in the brain predicted by these physiological hypotheses.

Psychological Mechanisms

Several psychological mechanisms have also been proposed. As was the case with the physiological mechanisms, many of these theories have not been tested as explanations of the benefits of exercise for depression. Two psychological theories that have received attention in the literature and warrant further examination are the self-efficacy hypothesis and the distraction hypothesis.

Self-Efficacy

The enhancement of self-efficacy has been proposed as one mechanism by which exercise may help alleviate symptoms of clinical depression. Bandura's (1977, 1997) conceptualization of self-efficacy is derived from social cognitive theory and is defined as "a generative capability in which cognitive, social, emotional, and behavioral sub-skills must be organized and effectively orchestrated to serve innumerable purposes" (Bandura, 1997, pp. 36-37). Self-efficacy refers to the belief that one possesses the necessary skills to complete a task as well as the confidence that the task can actually be completed with the desired outcome obtained. Once efficacy beliefs have been formed, they will direct choice of behavior, goals that are chosen, persistence at a task, motivation and effort, expectations of success, and how one responds affectively (Bandura, 1997). Efficacy beliefs can vary in generality and strength. For example, a person may feel

efficacious across many different types of activities or may have high self-efficacy for only a few specific activities. Furthermore, an individual may have very strong efficacy beliefs that will persist in the face of obstacles and failures or efficacy beliefs may be rather weak and easily subject to change.

Efficacy to manage and direct oneself is also an important part of human functioning. Bandura (1997) contends that the individual must not only be able to regulate goal directed behaviors but that healthy people are also able to use regulatory strategies for their thoughts, feelings, and emotions. This idea of self-regulation has led to the investigation of the concept of coping self-efficacy. When faced with a stressful situation, people's beliefs about their ability to control the situation and regulate their response to the situation is a primary determinant of how they will respond. At times, a low sense of self-control can be more problematic than perceived inability to control the environment (Bandura, 1997). This idea of efficacy to regulate behavior or "cope" becomes very important when discussing those who suffer from mental illness.

Coping self-efficacy and its relationship with mental health has primarily been studied within the context of anxiety. Those with high coping efficacy have less anxiety during surgical procedures and need less pain medication after surgery than those with low efficacy (Bastone & Kerns, 1995; Litt, Nye, & Shafer, 1995). Individuals with anxiety disorders were also shown to have fewer catastrophic thoughts and were less likely to have a panic attack after undergoing interventions designed to enhance their coping self-efficacy (Sanderson, Rapee, & Barlow, 1989). Further, women with high coping efficacy have higher cognitive control efficacy, decreased perceived vulnerability to threat, and lower levels of anxiety compared to women with low efficacy (Ozer &

Bandura, 1990). Finally, stressful situations elicit decreased blood pressure and cardiac reactivity and lower levels of catecholamine secretion in study participants who have high coping efficacy (Bandura, Taylor, Williams, Mefford, & Barchas, 1985; Gerin, Litt, Deich, & Pickering, 1995). Coping self-efficacy is an important part of optimal functioning because perceived inability to cope with potential threats or stressful situations leads people to approach such situations anxiously and with a low sense of efficacy that they will perform the behavior successfully.

Bandura (1997), utilizing self-efficacy theory, describes how depressed people often feel inefficacious to bring about positive desired outcomes in their lives and have low efficacy to cope with the symptoms of their depression. This can lead to negative self-evaluation, negative ruminations, and faulty styles of thinking. Individuals who have low self-efficacy often blame themselves for negative life events and this negative explanatory style can worsen and prolong their depression (Peterson & Seligman, 1984). Another way in which low efficacy can contribute to depression is through the perceived inability to deal with negative thoughts and ruminations. Those with low efficacy to stop or restructure negative thoughts have have higher levels of depression (Kavanagh & Wilson, 1989). Furthermore, a low sense of efficacy to develop and maintain positive, satisfying social relationships can lead to and prolong bouts of depression (Bandura, Pastorelli, Barbaranelli, & Caprara, 1999; Holahan & Holahan, 1987).

Several different factors influence the development of efficacy beliefs. Four primary sources of efficacy information have been identified (Bandura, 1997). The best source of efficacy information appears to come from mastery experiences. When a person can repeatedly derive a course of action, follow a plan, and meet the desired

outcome in the face of changing situations and obstacles then they are likely to feel highly efficacious. On the contrary, repeated failures at such attempts to navigate through life can lead to decreased feelings of self-efficacy. A second source of efficacy information is vicarious experience. Modeling the behaviors of others who are successful can lead to heightened efficacy beliefs. Seeing others like oneself make successful attempts at some desired behavior or demonstrate effective coping can raise one's own efficacy beliefs. Verbal persuasion also has some power to alter efficacy beliefs. Encouragement and feedback from an influential, credible person can enhance feelings of efficacy. Finally, physiological and affective states provide efficacy information. If a stressful situation elicits high levels of arousal and negative affect, the person is likely to feel inefficacious to obtain the desired outcome.

I am suggesting here that exercise may provide an effective mode through which self-efficacy can be enhanced based primarily on its ability to provide the individual with a meaningful mastery experience. According to Bandura (1997), in order for an intervention to lead to enhanced coping self-efficacy it must teach the individual how to self-monitor behaviors, set goals, and utilize social support to maintain the desired behaviors. Further, Zeiss and colleagues (Zeiss, Lewinsohn, & Munoz, 1979) suggest that a variety of therapies can be beneficial in the treatment of depression if they provide a mastery experience that enhances the beliefs of patients that they can control their behavior, teach patients some skill perceived as important to them, encourage patients to utilize the skill to achieve some personal goal, and contribute the reduction in depressive symptoms to the patient's mastery and use of the skills. It is easy to conceive that a chronic exercise program could meet each of the qualifications mentioned. Learning how

to monitor exercise behaviors, set short and long term exercise goals, and positive support from the exercise instructor and significant others can all contribute to feelings of mastery. Therefore, perhaps the antidepressant properties of exercise are related to an enhanced sense of efficacy that results from a mastery experience.

As mentioned previously, mastery experiences are thought to have the most powerful influence on perceptions of efficacy. However, vicarious experience, verbal persuasion, and changes in physiological and affective states are also components of an exercise program that may influence efficacy beliefs. For example, seeing others learn to engage in and enjoy exercise may provide an opportunity for modeling. Further, positive feedback and encouragement from the exercise leader can be a form of verbal persuasion that aids in the development of efficacy beliefs. Finally, as one learns to exercise and becomes more physically fit, physiological states (i.e. increased heart rate, fatigue) tend to become less negative and affective responses to exercise are likely to be more positive. Therefore, the realization that exercise is becoming easier and less painful can also promote an enhanced sense of self-efficacy. Thus, engaging in an exercise program and the skills learned in an exercise setting may lead to an increase in feelings of self-efficacy.

Research examining the association between physical activity and self-efficacy has predominately focused on the enhancement of physical self-efficacy and efficacy to regulate exercise behaviors. Such studies have examined the relationship between an individual's perceived efficacy to exercise and the amount of physical activity in which he or she engages, ways to increase a person's confidence in his or her ability to engage in an exercise program, and strategies to increase self-regulatory behaviors when

confronted with perceived barriers such as a lack of time, fatigue, etc. (Beniamini, Rubenstein, Zaichkowksy, & Crim, 1997; Ewart, Stewart, Gillilan, & Kelemen, 1986; McAuley, 1992; McAuley & Courneya, 1992; McAuley, Lox, & Duncan, 1993). The relationship between exercise and self-efficacy in the clinically depressed has not been studied extensively. The findings of the few studies that have examined this relationship have been equivocal as to whether exercise leads to an enhancement of generalized feelings of efficacy and have failed to examine whether involvement in an exercise program can promote coping self-efficacy specific to one's depression (Brown, Welsh, Labbe, Vitulli, & Kulkarni, 1992; Singh, Clements, & Fiatarone, 1997). Enhanced feelings of coping have been associated with exercise participation in anxious adults (Steptoe, Edwards, Moses, & Mathews, 1989), however, as mentioned previously, this relationship has not been examined with the clinically depressed. Therefore, the role that exercise can play in augmenting the coping self-efficacy of depressed patients needs further examination.

Distraction

The concept of distraction has also been proposed as a possible explanation for the antidepressant effects of exercise. This hypothesis suggests that physical activity serves as a distraction from worries and depressing thoughts. A theory of depression that is conceptually related to this potential mechanism is the response styles theory (Nolen-Hoeksema, 1991). This theory discusses two different dispositional ways in which individuals may respond to feelings of depression and how these differing responses can affect the severity and length of a depressive episode. Rumination is a response style that involves the tendency to passively and repeatedly focus on one's negative feelings and

the consequences of those feelings. Distraction refers to a response style in which the one busies herself in an engaging activity (i.e. a hobby, work) in an attempt to focus on something other than the depressed mood.

Rumination is thought to influence the course of depression in at least four ways. First, rumination may lead to negative thoughts and attributions about the self, past, present, and future which can contribute to a continued depressed mood (Lyubomirsky & Nolen-Hoeksema, 1995). Second, rumination may interfere with the initiation of problem-solving behaviors. Individuals who focus on their negative thoughts rather than engage in activities to solve their problems are at risk for prolonged bouts of depression (Nolen-Hoeksema, Parker, & Larson, 1994). Third, those who ruminate about their depression may not engage in behaviors that provide the opportunity for positive reinforcement and an enhanced sense of control (Lyubomirsky & Nolen-Hoeksema, 1993). Without such opportunities, feelings of helplessness, negative evaluations of self, lowered expectancies for the future, and a lack of motivation to meet new challenges may prevail (Nolen-Hoeksema, 1991). Fourth, the tendency to ruminate often alienates sources of social support (such as family and friends) who may grow tired of hearing the individual contemplate his depression (Nolen-Hoeksema & Davis, 1999).

The use of distracting activities, however, has been shown to have a more positive influence on the management of depression. Study participants who engaged in distracting activities showed a greater reduction in their depression than did those assigned to ruminating activities (Morrow & Nolen-Hoeksema, 1990; Nolen-Hoeksema & Morrow, 1991). Further, patients seeking treatment for mood disorders who were willing to engage in distracting activities as part of cognitive-behavioral therapy were less

depressed at follow-up than those who did not engage in distracting activities (Burns & Nolen-Hoeksema, 1991). Distraction often leads to enhanced mood. This temporary elevation of mood allows for more effective problem solving related to one's depression (Nolen-Hoeksema, Morrow, & Fredrickson, 1993). Finally, depressed people who engage in distracting activities to cope with their symptoms are less likely to engage in risky or violent behaviors as compared to those who ruminate on their depression (Nolen-Hoeksema & Morrow, 1991).

Research related to response styles theory indicates that women spend more time engaging in rumination than men, that men tend to use distraction more than women, and that those with a ruminative response style generally have more severe and longer lasting episodes of depression than those who use distraction as a response style (Just & Alloy, 1997; Morrow & Nolen-Hoeksema, 1990; Nolen-Hoeksema & Morrow, 1991; Nolen-Hoeksema et al., 1993). Therefore, based on the current research, a distraction response style appears to be associated with a more positive outcome for individuals who are depressed (Nolen-Hoeksema, 1998, 1991).

Nolen-Hoeksema (1991) cautions that not all activities are distracting and that rumination can still occur in spite of involvement in many activities. To ensure that a particular activity is an effective distractor, it must engage the individual and have a high probability of providing opportunities for positive reinforcement (Nolen-Hoeksema, 1991). The very nature of exercise makes it a potentially distracting activity worthy of investigation. During a workout, exercise related goals and attending to somatic changes such as breathing, heart rate, fatigue, and sore muscles often become the focus of attention (Leith, 1994). Furthermore, exercise offers the opportunity for positive

reinforcement as training goals are met, daily workouts become less painful and fatiguing, and significant others reward the individual for taking a proactive role in the management of her symptoms. Therefore, the antidepressant effects of exercise may result from the ability of exercise to provide periodic distraction from negative thoughts and feelings of depression. As mentioned previously, this temporary attenuation of depressed mood may allow for more effective engagement in problem-solving behaviors.

Response styles theory has not yet been tested with depressed people who engage in an exercise program as a distracting activity. Exercise has been compared to other distracting activities such as relaxation, assertiveness training, health education, and social contact (Doyne et al., 1983; Klein et al., 1985; McNeil, LeBlanc, & Joyner, 1991; Singh, Clements, & Fiatarone, 1997). Results have been inconclusive with exercise more effective than some activities and similar to others in its ability to aid in the reduction of depression. This line of research, however, has only examined the effect of these activities on symptoms of depression. It is proposed here that an exercise program may lead to a behavioral alteration in response style. Exercising participants may learn to spend less time in rumination and, instead, engage in distracting activities as a means to elevate mood. Therefore, research is needed to determine if physical activity reduces the tendency to ruminate and enhances the tendency to utilize distracting activities as a way of dealing with depression.

Mood Elevation Following Acute Bouts of Exercise

While it has not been formally proposed as a potential mechanism for the antidepressant effects of exercise, it is conceivable that transient mood elevation following repeated acute bouts of exercise might be associated with reductions in the

symptoms of clinical depression. It is known that people normally experience a wide range of moods such as happiness, sadness, anger, distress, fear, enthusiasm, etc. While exercise has been shown to be effective in managing the symptoms of more severe mood disorders such as anxiety and depression (Craft & Landers, 1998; Landers & Petruzzello, 1994), there is also a popular notion that exercise can have a positive influence on normal variations in mood. While the relationship of transient mood enhancement with clinical depression has not been examined in the exercise science literature, the ability of exercise to enhance mood in the general population has long been a popular area of investigation.

The relationship between exercise and mood has historically been examined by utilizing self-report inventories such as the Profile of Mood States (POMS), the Mood Adjective Checklist, and the Positive Affect and Negative Affect Schedule (PANAS). These inventories assess both positive (i.e. excited, inspired, vigor) and negative (i.e. tension, fatigue, guilt) dimensions of mood. Researchers were initially interested in the ability of exercise to improve negative mood states and have predominantly utilized pre-test/post-test designs to examine changes in mood following exercise. Findings indicate that exercise can reduce negative aspects of mood such as anger, tension, depression, anxiety, fatigue, and confusion (Berger & Owen, 1988; Fremont & Craighead, 1987; Markoulakis & Zervas, 1993; McGowan, Talton, & Thompson, 1996; McGowan & Pierce, 1991; Yeung, 1996). Fewer studies have examined the effects of exercise on the positive aspects of mood, but it appears that exercise also enhances positive emotions like vigor, excitement, liveliness (Arent, Landers, & Etnier, 2001; McIntyre, Watson, & Cunningham, 1990; Petruzzello, Jones, & Tate, 1997; Steptoe & Cox, 1988; Tate & Petruzzello, 1995).

Several variables such as gender, type of exercise, duration, intensity, and frequency of exercise have been considered as potential moderators of the effect of exercise on mood. Studies examining gender differences have reported mixed results. While exercise can elevate mood for both males and females, the effects may be larger for women (Berger, Owen, Motl, & Parks, 1998; Roth, 1989; Stephens, 1988). Furthermore, several different kinds of exercise have been investigated such as walking, running, swimming, cycling, aerobic dance, karate, and strength training (Berger & Owen, 1993; Blumenthal et al., 1982; Fremont & Craighead, 1987; Hartz, Wallace, & Cayton, 1982; Maroulakis & Zervas, 1993; McGowan et al., 1993; McGowan & Pierce, 1991; McGowan et al., 1996). Each of these exercises were associated with enhanced mood and one type did not have a distinct advantage over any other type.

As for the optimal duration of the exercise bout, the literature remains unclear. Studies have been conducted utilizing different durations of exercise (i.e. Berger & Owen, 1983; Flory & Holmes, 1991; Thayer et al., 1993), however, there are fewer studies that have actually compared varying durations of exercise and their effects on mood (i.e. Hanson, Stevens, & Coast, 2001; Hobson & Rejeski, 1993). Hansen, Stevens, and Coast (2001) recently compared the mood enhancing effects of 10, 20, and 30 min of exercise. They reported that mood was improved following as little as 10 min of exercise with continued improvement through 20 min. There were no additional benefits to mood with 30 min of exercise. Therefore, the current general recommendations of 20 - 30 min of exercise appear supported but more information is needed regarding longer bouts of exercise.

Intensity of exercise does seem to play an important role in the relationship between mood and exercise. Moderate intensity exercise appears most beneficial for improving mood and mood tends to become more negative as exercise intensity increases (Berger & Owen, 1998; Hardy & Rejeski, 1989; McGowan et al., 1996; Moses et al., 1989; Parfitt, Eston, & Connolly, 1996; Steptoe & Cox, 1988). Various frequencies of exercise have also been considered with as few as one exercise bout per week and as many as seven bouts per week associated with enhanced mood (Hartz, et al., 1982; Roth, 1989; Steptoe, Kearsley, & Walters, 1993; Wilson et al., 1980). It remains unknown what exercise frequency is associated with the largest improvements in mood.

Many of the studies examining this relationship have utilized chronic exercise programs (i.e. Berger & Owen, 1983; DiLorenzo et al., 1999; Fremont & Craighead, 1987; Steptoe et al., 1993; Wilson et al., 1980). Acute bouts of exercise, however, have also been investigated. Single bouts of exercise can also have a positive effect on mood (Hansen et al., 2001; Kennedy & Newton, 1997; McGowan, Pierce, & Jordan, 1991; McGowan et al., 1996). Elevated mood has been noted at 15 min, 30 min, and even 24 hr following an exercise bout, but more information is needed (Dyer & Crouch, 1988; Hansen et al., 2001; Maroulakis & Zervas, 1993; McMillan et al., 1993; Steptoe et al., 1993). Further, the potential interactions of exercise intensity, exercise duration, and length of mood enhancement warrant continued investigation (Landers & Arent, 2001).

The overwhelming majority of studies in this area have been conducted with college students or healthy adults as participants. Little is known about the mood enhancing effects of exercise in those suffering from mental health problems. Two studies were located that examined this relationship in depressed individuals involved in

chronic exercise programs (Fremont & Craighead, 1987; Hartz et al., 1982). Fremont and Craighead (1987) reported improvements in depression, confusion, anxiety, anger, fatigue, and vigor following a 10-week running intervention. Mood enhancement was reported as early as 3 weeks after the initiation of the intervention. Hartz et al. (1982), however, found that exercise had mood-elevating effects for two of their participants but not for the participant group as a whole. No studies were located that examined the effects of an acute bout of exercise on mood in clinically depressed patients.

The opponent process theory (Solomon, 1980) can provide a theoretical foundation on which one could make predictions regarding the mood enhancing effects of acute exercise. This theory states that as an individual engages in an arousing activity there are two opposing processes that are occurring simultaneously. The predominate response is termed the "A" state. This is the stimulating or arousing response and is initially quite strong and weakens across time. The opposing response is termed the "B" state. This response is in opposition to the "A" state and attempts to return the body to homeostasis. The "B" state is initially weak but strengthens across time. With continued exposure to the arousing activity, the "A" state weakens and the "B" state strengthens. Using exercise as an example, we could predict that when initiating an exercise program the "A" state is initially unpleasant. For example, the individual may feel fatigued, have sore muscles, feel short of breath, etc. The "B" state, conversely, is in opposition to the negative feelings of the "A" state, is shorter lasting initially, and is generally pleasant (i.e. relaxation, stress reduction). Over time, we would expect that the "A" state would shorten leading to less negative feelings associated with exercise and the "B" state would lengthen leading to more enhanced longer lasting feelings of improved mood.

A study that has tested this theory within the confines of acute exercise was conducted by Petruzzello and colleagues (Petruzzello et al., 1991). They found partial support for the theory in that post exercise affective states were more positive than affective states during exercise. However, prior exposure to exercise did not moderate the affect as anticipated. This theory needs further examination with the clinically depressed. It would be advantageous to researchers and clinicians to understand at what point in a chronic exercise intervention individuals may begin to feel mood elevation after each acute bout of exercise and how long such mood elevation is likely to last. In addition, the potential relationship between such transient mood elevation and symptoms of depression warrants exploration. Information of this sort will help clinicians when educating depressed patients on the benefits of involvement in physical activity programs.

To conclude, the current literature suggests that exercise is an effective adjunct therapy in the treatment of clinical depression. Little is known, however, regarding the ways in which exercise exerts its positive influence. Coping self-efficacy, distraction, and transient mood elevation have been proposed here as potential psychological mechanisms for the antidepressant effects of exercise. However, experimental research is needed to test the theories related to these suggested mechanisms. Gaining insight into how exercise works to reduce symptoms of depression will not only further our scientific knowledge but will also aid clinicians in the use of exercise as a treatment for those suffering from clinical depression.

CHAPTER THREE

Method

Participants and Design

Prior to data collection, study approval was obtained from the Institutional Review Board (See Appendix A). Further, participants in this study signed an informed consent (See Appendix A). All women in this study were Caucasian and the average age of the participants was 43.21 years (SD = 13.23).

Initially, an experimental design with random assignment of participants to study groups was planned. All participants who met study inclusion criteria indicated their desire to be in the exercise intervention group. Of the 24 women originally recruited into the study, only 2 attended the first study organizational meeting. Follow-up contact with the other 22 women resulted in several women who were still willing to participate and several women who indicated that they no longer desired to participate in the study. The women expressed a variety of reasons for no longer wishing to participate such as a lack of time, personal illness or illness of family members, unwillingness to drive to campus twice per week, etc. These women were asked if they would be willing to be control group members. Some of the women agreed to be in the control group and others declined. Therefore, a non-equivalent control group design (quasi-experimental) was utilized and these remaining participants were assigned to their choice of either the control group or the exercise intervention group.

Subsequently, 10 women chose to participate in the control group and 11 women chose the exercise intervention group. There were two women who dropped out of the study, both in the exercise intervention group. These participants attended the first

exercise session which consisted primarily of information regarding stretching, monitoring heart rate, and familiarization with the exercise equipment. Neither of these women returned to the study after this initial session. One participant stated that she was too busy to take part in the study and the other woman elected to enter psychotherapy and was therefore no longer eligible for the study. There were no further dropouts in either the control or exercise group, leaving a total of 10 in the control group and 9 in the exercise group.

All women were suffering from physician diagnosed clinical depression. Further, participants were receiving pharmacological treatment for their depression (for at least 4 weeks prior to study entry) but were not receiving any additional psychological treatments. Participants reported current episodes of depression lasting a mean of 17.47 months (SD = 28.75). Further, they had been taking their current medications for a mean of 47.26 months (SD = 47.55). Participants were excluded if they were currently involved in a regular exercise program (at least 3 days per week) or if they had been involved in an exercise program at any time in the past year. Participants were also excluded if they were concurrently suffering from another mental illness, were currently undergoing any treatment other than pharmacological interventions for their depression, or if they had any physical illness that would contraindicate exercise.

Participants were recruited from area physicians, advertisements placed in local newspapers, and posted flyers. Participants were informed that the purpose of the study was to examine various treatments for clinical depression. All participants maintained normal contact with their physician and continued pharmacological treatment during the length of the study. Further, they were asked to report to the primary investigator any

change in antidepressant medication or medication dosage during the course of the study. All participants who completed the 9-week study received $25.00 for their participation.

Questionnaires

Demographic. A questionnaire designed to gather demographic information was administered to all participants. This questionnaire assessed a variety of variables such as ethnicity, age of onset of first depressive episode, number of hospitalizations for depression, current antidepressant medication, current physical health problems, etc. This questionnaire is contained in Appendix B.

Exercise program readiness questionnaire. Participants assigned to the exercise intervention group completed this 10-item questionnaire. This inventory assessed health status and risk factors (i.e. dizziness, history of heart attack, excessively overweight) that would indicate the need for medical evaluation prior to beginning an exercise program. Any woman who answered "yes" to at least one of the questions and all women over the age of 40 were required to consult with their physician and provide a physician's signature indicating the participant's suitability to engage in the moderate intensity exercise program. This questionnaire is contained in Appendix C.

Beck Depression Inventory-II (Beck, Steer, & Brown, 1996). The BDI-II is a 21-item self-report inventory designed to assess the behavioral and cognitive symptoms of depression. Each item consists of several statements describing symptoms of depression. The participant is asked to circle the statement that best describes her symptoms related to that particular aspect of depression (i.e. feelings of guilt, changes in sleep). The statements are numbered from "0" to "3", with higher numbers indicating more severe symptoms. Scores for responses are summed to obtain an overall score. The overall sum

can range from 0 to 63, with higher scores indicating more severe depression. This inventory has demonstrated acceptable internal consistency with the authors reporting Cronbach's alphas ranging from .92-.93. Internal consistency for this study was examined using Cronbach's alpha and was deemed acceptable with $\alpha = .91$. This questionnaire is contained in Appendix D.

Depression Coping Self-Efficacy Scale (Perraud, 2000). The DCSES is a 24-item inventory designed to assess the coping self-efficacy of depressed patients. The inventory asks participants to rate their confidence in their ability to engage in a variety of coping responses from 0 (not at all confident) to 10 (confident). The ratings for all items are summed and a mean score is calculated. This inventory has demonstrated acceptable internal consistency with the author reporting Cronbach alphas ranging from .93-.96. Internal consistency was also acceptable for the DCSES in this study ($\alpha = .82$). This questionnaire is contained in Appendix E.

Responses Style Questionnaire (Nolen-Hoeksema & Morrow, 1991). This RSQ assesses how an individual generally responds to feeling sad, down, or depressed. The inventory has two subscales: the Ruminative Response Scale, which has 22 items and assesses the tendency to respond to depression with self-focused behaviors and the Distractive Response Scale, which has 11 items and assesses the tendency to engage in distracting activities as a response to depression. The participant rates each response item on a scale from 1 (almost never) to 4 (almost always). An overall score for each subscale is obtained by summing responses. This inventory has demonstrated acceptable internal consistency (Ruminative Response Scale: $\alpha = .89$ and Distractive Response Scale: $\alpha = .80$) (Nolen-Hoeksema & Morrow, 1991). In this study, the two subscales of the RSQ

were found to be internally consistent (Ruminative Response Scale, $\alpha = .88$; Distractive Response Scale, $\alpha = .71$). This questionnaire is contained in Appendix F.

Rating of Perceived Exertion (Borg, 1982). In an attempt to check the participants' perception of the exercise intensity and to determine if perceptions of effort were related to enjoyment of the exercise bout, participants rated their perception of effort exerted during exercise using Borg's Rating of Perceived Exertion (RPE) scale. This scale ranges from the numbers six to 20 with adjectives such as "very light", "hard", and "very, very hard" anchored along the numerical scale. Participants were asked to select the number that best described the intensity at which they felt they were working. This scale is contained in Appendix G.

Rating of enjoyment of exercise. For each exercise session, participants rated their level of enjoyment for the exercise bout on a 7-point Likert type scale. The scale was anchored at -3 (not at all), 0 (undecided), and 3 (very much so). This inventory was developed for the purposes of this study. This scale is contained in Appendix H.

Rating of mood. This inventory was also developed for the current study and asked participants to rate their mood on a 7-point Likert type scale. This scale was also anchored at -3 (sad, negative, down), 0 (neutral), and 3 (happy, positive, upbeat). Participants rated their mood immediately prior to, immediately following, and 5, 10, and 15 min following the exercise bout. This scale is contained in Appendix H.

Procedure

All participants completed the demographic questionnaire, BDI-II, DCSES, and RSQ at study entry, prior to the beginning of the exercise intervention. A 9-week intervention was planned based upon the results of the Craft and Landers' (1998) meta-

analysis which indicated that exercise interventions of 9-weeks or longer were most effective in alleviating symptoms of depression. Therefore, participants in the control group were followed for 9 weeks. Members of this group completed the BDI-II, the DCSES, and the RSQ again after 3, 6, and 9 weeks. These three questionnaires were counterbalanced in terms of order of administration over the three time periods. Questionnaires were mailed to participants, which allowed them to complete the inventories privately and conveniently. Individuals in this group were instructed not to begin an exercise program during the 9 weeks of the study.

Those in the exercise group began an exercise intervention consisting of 3 days per week of moderate intensity physical activity. Participants exercised, in groups of 2-4, twice per week and also completed one exercise session per week at home on their own. Each exercise session consisted of a brief (5 min) session of stretching followed by exercise on stationary cycle ergometers and treadmills. The first week of the study consisted of familiarizing participants with stretching techniques, monitoring heart rate via radial or carotid pulse, and how to properly use the exercise equipment. The participants in this study were very sedentary and, as such, Weeks 2-3 of the study were conducted at a "comfortable" pace for a total of 20 min. For the remaining 6 weeks of the study, participants were asked to ride or walk at 50-75% of HRR for the 30-min bout with heart rate monitored throughout to ensure the appropriate exercise intensity was maintained for the entire bout. The exercise bout was followed by a brief (5 min) cool down period and 5 min of stretching. For the home based exercise sessions, participants were free to engage in whatever type of exercise activity they chose. Aerobics video-tapes were provided to participants to assist them in their home based session. For the

home based activity, participants were instructed to follow the general exercise protocol of stretching, monitoring heart rate throughout exercise, cool-down, post-exercise stretch, etc. During each exercise session, participants reported their current mood immediately prior to and following the exercise bout. They then continued to rate their mood every 5 min for the 15 min immediately following the exercise session. Participants also rated their level of enjoyment for the exercise bout as well as their perceived exertion for the exercise session. This intervention lasted 9 weeks with the participants completing the previously described questionnaire battery (BDI-II, DCSES, RSQ) at study entry, 3, 6, and 9 weeks. These questionnaires were counterbalanced in terms of order of administration across the three time periods. The participants in the exercise group also completed the questionnaires at home and then returned them to the study investigator.

The researcher attempted to facilitate a mastery experience during this 9-week exercise intervention. During Weeks 1-3, the researcher guided the participants through their stretching, assisted them in monitoring their heart rates, provided them with a target heart rate range based on HRR, helped them regulate the intensity of their exercise session, etc. During Weeks 4-6, the participants took a more active role in the process. They stretched on their own, monitored their own heart rate, and attempted to adjust their exercise intensity to remain within their target heart rate range. They were also given information on how to calculate their target heart rate range. During the final 3 weeks of the intervention, the participants were responsible for the entire exercise session. They stretched on their own, computed their target heart rate range, monitored their heart rates and exercise intensity, completed the 30-min exercise bout, and cool down period without assistance from the researcher. The researcher was present to answer questions but

encouraged the participants to complete the workout session on their own. Furthermore, having the participants exercise one day per week on their own should have assisted in the development of a mastery experience.

Analyses

Descriptive statistics were computed for subject characteristics and study variables. To check for potential group (i.e. control, exercise) differences at study entry, subject characteristics were examined using student's *t* tests for continuous variables and Chi square analyses for categorical variables. A one-way analysis of variance (ANOVA) was conducted to check for pre-existing group differences on study dependent variables (depression score, coping self-efficacy, and response style).

To test the first three study hypotheses, four separate repeated measures multivariate analysis of variance (MANOVAs) were utilized to examine group (control, exercise) differences across time on BDI-II (depression), DCSES (coping self-efficacy), and RSQ (rumination and distraction). In an attempt to increase statistical power for these multivariate tests, data obtained at 6 weeks was not utilized. Therefore, time points used for the repeated measures MANOVAs were study entry, 3 weeks, and 9 weeks. Follow-up univariate analysis of variance (ANOVA) was utilized to determine group differences at each time point (i.e., whether the exercise or control group had higher mean scores). Within subjects repeated measures MANOVA was then conducted to determine at what time points these group differences occurred (i.e. if change occurred from study entry to Week 3 or from Week 3 to Week 9). Effect sizes (Cohen's *d*) were also calculated for dependent variables at Week 3 and Week 9 using a pooled standard deviation as described by Hedges & Olkin (1985).

To test the fourth hypothesis that coping self-efficacy, rumination, and distraction would be related to depression score, standard multiple regression analyses were conducted. Regression analyses were conducted at Week 3 and Week 9. The best predictors of depression score at those two time points were examined.

Finally, exploratory analyses were conducted to determine potential relationships between acute mood and symptoms of depression. Data related to the participants' rating of pre-exercise mood, post-exercise mood, length of the mood elevation, enjoyment of the exercise session, and RPE were first collapsed. Beginning with Week 2 of the study (Week 1 was primarily informational and mood data was not collected), averages for pre-exercise mood, mood immediately post-exercise, length of mood elevation, enjoyment, and RPE were calculated for 3 time periods: Time 1 (Weeks 2-3), Time 2 (Weeks 4-6) and Time 3 (Weeks 7-9). Within-subjects (time) repeated measures MANOVAs were conducted to determine if these average ratings changed across the course of the study. Pearson's correlations were also conducted to examine relationships between BDI-II, DCSES, RSQ, pre-exercise mood, post-exercise mood, enjoyment, and RPE for each of the three time periods.

CHAPTER FOUR

Results

At study entry, the two groups did not differ significantly ($p > .05$) on age, marital status, level of education, age that depression was first diagnosed, number of prior hospitalizations for depression, severity of depression, or type of antidepressant medication. Subject characteristics are presented in Table 1. Overall, adherence to the exercise program was good among the members of the exercise group. Most participants who missed sessions scheduled make-up sessions in order to complete the study protocol of 3 sessions total per week. Participants in the exercise group completed a mean of 23.3 sessions. This was 86.4 % of the scheduled sessions.

Scores for dependent variables (severity of depression, coping self-efficacy, and use of rumination and distraction) at study entry were examined using ANOVA and results showed that the two groups did not differ significantly [BDI-II: $F(1, 18) = .55, p = .47$; DCSES: $F(1, 18) = 2.28, p = .15$; Rumination: $F(1, 18) = 1.03, p = .33$; Distraction: $F(1, 18) = 3.45, p = .08$]. Means and standard deviations for these study variables for all time points are presented in Table 2.

To test the first hypothesis that a chronic exercise intervention would be associated with a reduction in depression, a Group (control, exercise) X Time (study entry, 3 weeks, 9 weeks) repeated measures MANOVA was conducted. The Group X Time interaction was significant (Wilks' $\lambda = .66, F(2,16) = 4.2, p < .05$) as was the within subjects main effect for Time (Wilks' $\lambda = .56, F(2,16) = 5.5, p < .05$). The between subjects main effect for Time was also significant, $F(1,17) = 7.0, p < .05$. Follow-up tests for the interaction using univariate ANOVA indicated that the exercise

Table 1

Subject Characteristics.

	Control ($N = 10$) Mean (*S.D.*)	Exercise ($N = 9$) Mean (*S.D.*)	t or X^2	p
Age (years)	42.9 (13.3)	43.6 (13.9)	$t = -.11$	0.92
Age first diagnosed (years)	28.8 (12.5)	31.1 (13.3)	$t = -.39$	0.70
Number of prior hospitalizations for depression	0.1 (0.3)	0.6 (1.1)	$t = -1.17$	0.24
BDI-II score (Severity of depression)	24.9 (12.6)	21.2 (8.4)	$t = .74$	0.47
Marital status			$X^2 = 2.04$	0.57
Single	3.0	3.0		
Married	5.0	6.0		
Widowed	1.0	0.0		
Separated	1.0	0.0		
Highest level of education achieved			$X^2 = 2.25$	0.32
High School	4.0	1.0		
College	3.0	5.0		
Graduate School	3.0	3.0		
Type of antidepressant medication			$X^2 = 0.57$	0.75
SSRI	6.0	5.0		
Pre/Post Seratonin	3.0	3.0		
Norepi/Dopamine	2.0	2.0		

Table 2

Means and Standard Deviations Across Time on BDI-II, DCSES, and RSQ.

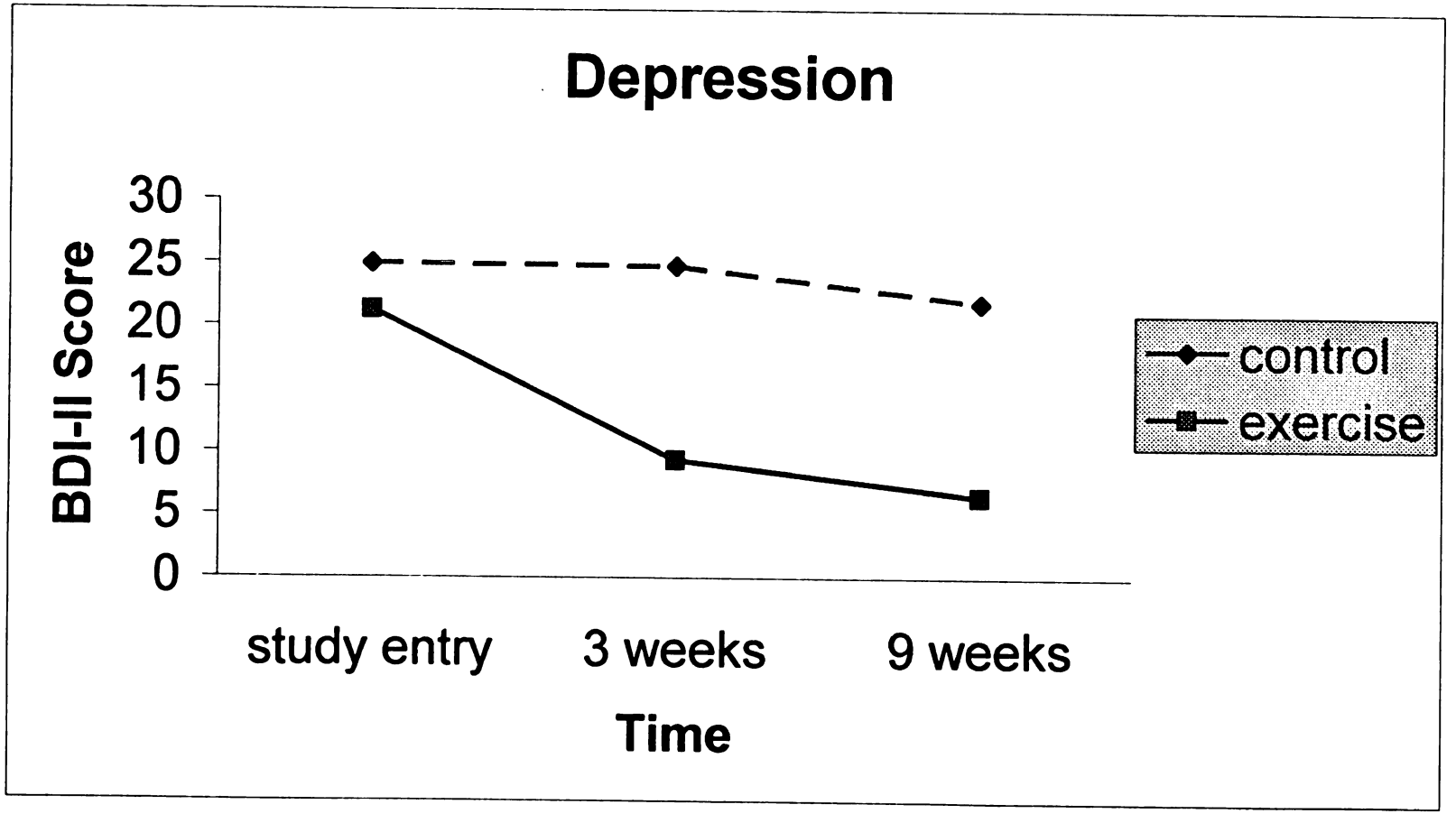
	Study Entry		3 weeks		6 weeks		9 weeks	
	Control	Exercise	Control	Exercise	Control	Exercise	Control	Exercise
BDI-II	24.9 (12.6)	21.2 (8.4)	24.7 (12.0)	9.3 (4.8) ES = -1.2	23.6 (13.7)	10.8 (5.2) ES = -1.2	21.8 (16.4)	6.4 (5.4) ES = -1.2
DCSES	6.0 (1.2)	6.8 (1.0)	5.2 (1.3)	7.3 (0.9) ES = 1.9	5.3 (1.3)	7.4 (1.1) ES = 1.7	5.3 (1.8)	7.5 (0.9) ES = 1.5
Rumination	48.0 (9.1)	43.8 (9.0)	46.5 (8.2)	38.9 (1.8) ES = -1.3	46.7 (11.3)	36.1 (5.2) ES = -1.2	44.0 (10.9)	33.9 (1.2) ES = -1.3
Distraction	23.4 (3.1)	26.6 (4.3)	23.6 (3.0)	28.6 (1.2) ES = 2.2	22.3 (3.3)	27.6 (3.8) ES = 1.5	23.7 (5.3)	27.7 (2.1) ES = 1.0

group was less depressed than the control group at 3 weeks, $F(1,18) = 12.8, p < .01$, and at 9 weeks, $F(1,18) = 7.1, p < .05$. Within subjects repeated measures MANOVA indicated that the control group did not significantly reduce their depression scores from study entry to 3 weeks, Wilks' $\lambda = .10, F(1,9) = .01, p > .05$, or from 3 weeks to 9 weeks, Wilks' $\lambda = .92, F(1,9) = .80, p > .05$. Further, the exercise group had a significant reduction in depression from study entry to 3 weeks, Wilks' $\lambda = .41, F(1,8) = 11.4, p < .01$, but no further reduction from 3 weeks to 9 weeks, Wilks' $\lambda = .72, F(1,8) = 3.1, p > .05$. This indicates that exercise was associated with a reduction in depression by 3 weeks time and this reduction in depression in the exercise group was maintained to the end of the 9-week study. Means, standard deviations, and effect sizes for depression scores across time are presented in Table 2. Figure 1 represents the significant Group X Time interaction.

The second hypothesis predicted that coping self-efficacy would increase across time in members of the exercise intervention. Repeated measures MANOVA, using coping self-efficacy as the dependent variable, showed that there was a significant Group X Time interaction [Wilks' $\lambda = .50, F(2,16) = 8.2, p < .01$]. The within subjects main effect for Time was not significant, Wilks' $\lambda = .90, F(2,16) = .93, p > .05$. The between subjects main effect for Group was also significant, $F(1,17) = 17.2, p < .01$. Results of follow-up univariate ANOVA for the interaction indicated that the exercise group had higher coping efficacy at 3 weeks [$F(1,18) = 16.6, p < .01$] as well as at 9 weeks [$F(1,18) = 10.1, p < .01$]. Within subjects repeated measures MANOVA indicated that both the control group and the exercise group had a significant change in efficacy score from study entry to 3 weeks [Control group: Wilks' $\lambda = .52, F(1,9) = 8.5, p < .05$; Exercise

Figure 1

Group X Time Interaction for BDI-II Score.

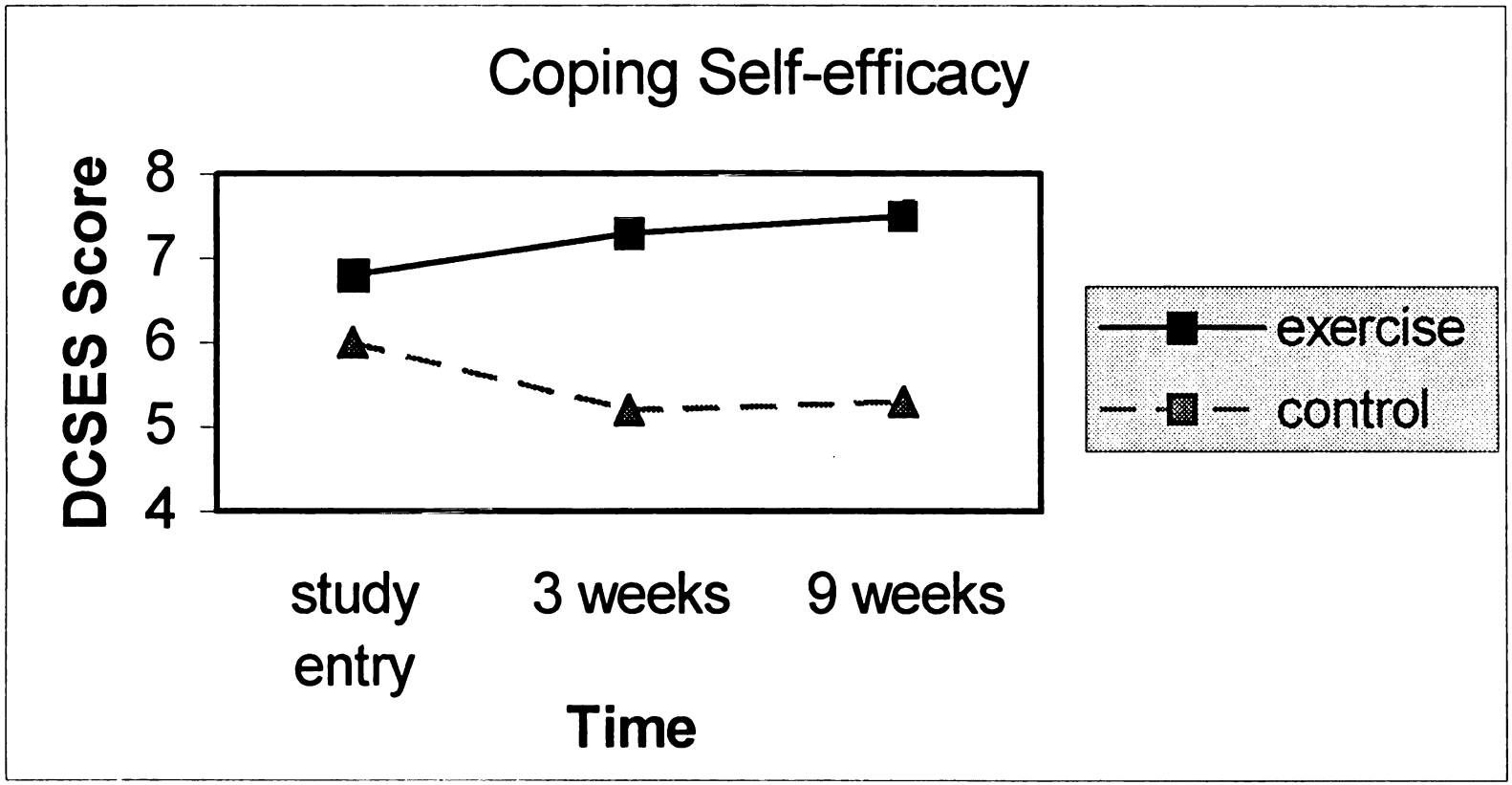


group: Wilks' $\lambda = .60$, $F(1,8) = 5.3$, $p < .05$] but neither group showed further improvement from 3 weeks to 9 weeks [Control group: Wilks' $\lambda = .10$, $F(1,9) = .02$, $p > .05$; Exercise group: Wilks' $\lambda = .96$, $F(1,8) = .33$, $p > .05$]. The two groups both demonstrated changes in efficacy score across the 9-week study. The exercise group increased their self-efficacy score, while efficacy decreased in the control group. This may have contributed to the significant Group X Time interaction. However, those in the exercise intervention showed significantly greater increases in coping self-efficacy than those in the control group. This increased efficacy emerged by 3 weeks time and was maintained throughout the remainder of the study. Means, standard deviations, and effect sizes across time for coping self-efficacy are presented in Table 2. Figure 2 represents the significant Group X Time interaction.

The third hypothesis predicted that those in the exercise intervention would report a decreased tendency to use ruminative strategies and an increased use of distraction techniques across time. Repeated measures MANOVA was first conducted with rumination as the dependent variable. The Group X Time interaction was not significant [Wilks' $\lambda = .89$, $F(2,16) = 1.0$, $p > .05$], but the main effect for time was significant [Wilks' $\lambda = .56$, $F(2,16) = 6.3$, $p < .01$]. The test of between subjects main effect for Group was also significant [$F(1,17) = 4.9$, $p < .05$]. These findings suggest that, regardless of group (control, exercise), all participants decreased their use of ruminative strategies across time. Because group means appeared different and low statistical power was suspected for the non-significant Group X Time interaction, a follow-up univariate ANOVA was conducted. Results showed that the exercise group had significantly lower scores for use of rumination than the control group at 3 weeks [$F(1,18) = 5.5$, $p < .05$]

Figure 2

Group X Time Interaction for DCSES Score.



and at 9 weeks [F (1,18) = 7.0, p < .001]. Means, standard deviations, and effect sizes across time are presented in Table 2. Figure 3 represents the significant main effect for Time.

To determine whether the use of distraction increased across time more in the exercise group than in the control group, a repeated measures MANOVA using distraction as the dependent variable was conducted. The Group X Time interaction was not significant [Wilks' λ = .93, F (2,18) = .61, p > .05] and neither was the main effect for Time [Wilks' λ = .90, F (2,18) = .88, p > .05]. The between subjects main effect for Goup was significant [F (1,17) = 7.8, p < .05]. These findings suggest that there was not an increase in use of distraction across the 9 weeks of the study for either the control group or the exercise group. Again, because the group means appeared different and low power was suspected for the non-significant Group X Time interaction, univariate ANOVA was conducted for each time point to determine if the groups were different. Results indicated that exercise group members had a higher use of distraction techniques at 3 weeks [F (1,18) = 10.6, p < .01] but not at 9 weeks [F (1,18) = 2.2, p > .05]. Means, standard deviations, and effect sizes for distraction scores across time are presented in Table 2. Figure 4 represents the data for distraction scores across time.

Next, to test the hypothesis predicting that obtained levels of coping self-efficacy, rumination, and distraction would be related to current levels of depression, standard multiple regression analyses were conducted. The best predictors of depression score at study Week 3 and Week 9 were examined. At Week 3, depression score at Week 3 was entered as the dependent variable, with depression score at study entry (included as a covariate), self-efficacy, rumination, and distraction scores at Week 3 entered as

Figure 3

Main Effect for Time for RRS Score.

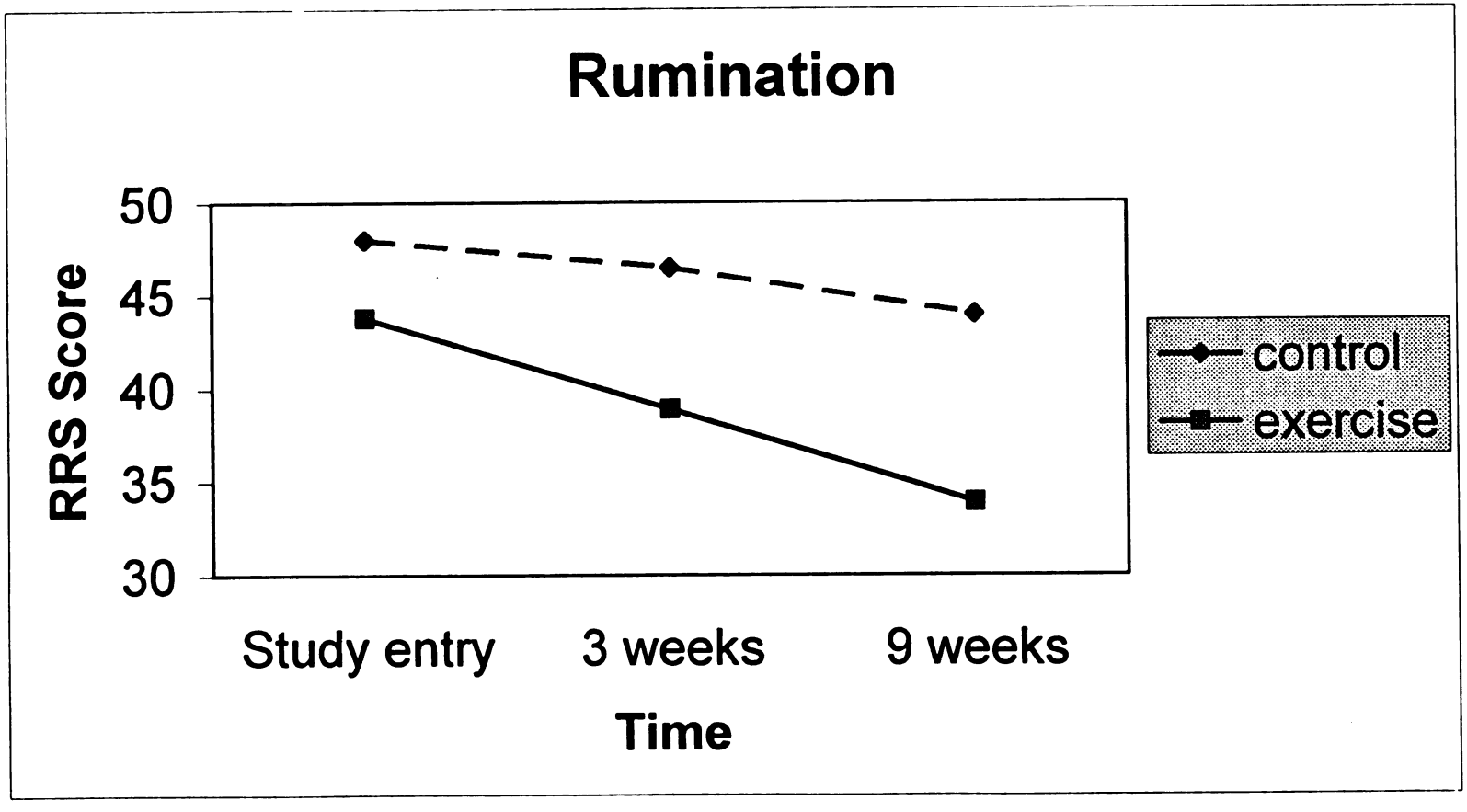
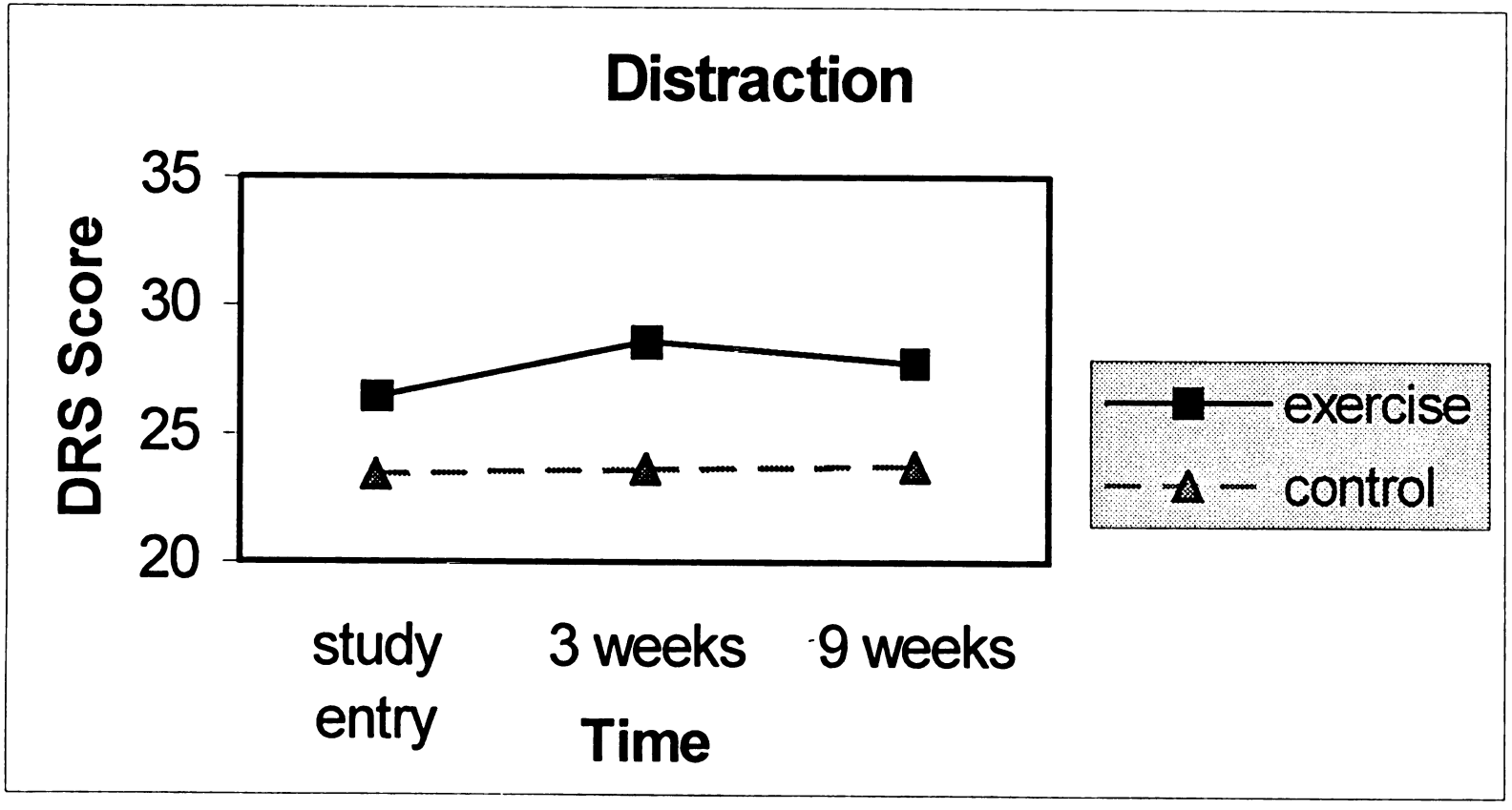


Figure 4

Scores on DRS.



predictors. Among exercisers, self-efficacy (β = -.74, p > .05) and study entry depression score (β = -.59, p > .05) were the best predictors of depression at Week 3. Although both predictors were non-significant, self-efficacy approached significance at p = .07. Each predictor had a negative relationship with the outcome, indicating that increased self-efficacy was related to a reduction in depression and that those with higher depression scores at study entry had the greatest improvement in depression by Week 3. These two variables accounted for 30.2% of the variance.

For the Week 9 time point, depression score at Week 9 was entered as the dependent variable and depression score at Week 3 (included as a covariate), self-efficacy, rumination, and distraction at Week 9 were entered as predictors. Self-efficacy (β = -.65, p < .05) was the best predictor of depression after controlling for depression at Week 3 (β = .29, p > 05). Self-efficacy had a significant negative relationship with depression score. Therefore, the higher one's self-efficacy, the lower one's depression score. These two variables accounted for 54.0% of the variance.

Finally, exploratory analyses were conducted to investigate the relationship between mood and depression. Pre-exercise mood, mood immediately post-exercise, length of mood enhancement, enjoyment, and RPE were examined. Length of mood enhancement for all participants for all exercise sessions was the full 15 minutes for which mood was assessed. In other words, post-exercise mood never returned to baseline (pre-exercise) values during any of the time points monitored during this study. Therefore, this variable was dropped from further analyses. Means and standard deviations for each of the other exercise mood variables at each time point are presented in Table 3. Within subjects repeated measures MANOVA indicated that there were no

Table 3

Means and Standard Deviations for Exercise Mood Variables.

	Weeks 2-3	Weeks 4-6	Weeks 7-9
	Time 1	Time 2	Time 3
Mood prior to exercise	0.6 (0.8)	0.7 (1.0)	1.0 (0.8)
Mood immediately post exercise	1.7 (0.9)	2.0 (0.6)	1.9 (0.5)
Enjoyment of exercise bout	1.4 (1.1)	1.9 (0.9)	2.1 (0.6)
Rating of perceived exertion	13.5 (0.9)	14.5 (1.5)	14.2 (1.5)

significant changes across time for any of the variables examined [Pre-exercise mood: Wilk's $\lambda = .70$, $F(2, 7) = 1.52$, $p = .28$; Mood immediately post-exercise: Wilk's $\lambda = .86$, $F(2, 7) = .60$, $p = .58$; Enjoyment of the exercise bout: Wilk's $\lambda = .56$, $F(2, 7) = 2.79$, $p = .13$; RPE: Wilk's $\lambda = .51$, $F(2, 7) = 3.32$, $p = .10$].

Pearson's correlations among mood variables and dependent variables for each time point resulted in several significant ($p < .05$) relationships. Correlations are presented in Tables 4-6. The changes across time among the relationships between RPE, post-exercise mood, enjoyment, and BDI-II score were the most interesting. The correlation between RPE and post-exercise mood shifted from a negative relationship ($r = -.31$) to a significant positive relationship ($r = .73$). Further, the relationship between RPE and enjoyment was small and non-significant ($r = .01$) early in the intervention but became stronger and significant ($r = .74$). Finally, the relationship between RPE and BDI-II score was initially strong and positive ($r = .75$) but became negative ($r = -.39$).

Table 4

Correlations Among Mood Variables and Dependent Variables at Time 1.

	1	2	3	4	5	6	7	8
1. Mood prior to exercise	-	.73*	.32	-.20	-.49	.51	-.40	.28
2. Mood immediately post exercise		-	.77*	-.31	-.20	.62	-.10	.75*
3. Enjoyment of the exercise bout			-	.01	.22	.31	.14	.54
4. Rating of perceived exertion				-	.75*	-.50	-.17	-.60
5. BDI-II score at 3 weeks					-	-.18	-.02	-.10
6. DCSES score at 3 weeks						-	-.32	.76*
7. Rumination Score at 3 weeks							-	.10
8. Distraction Score at 3 weeks								-

* Correlation significant at $p < .05$.

Table 5

Correlations Among Mood Variables and Dependent Variables at Time 2.

	1	2	3	4	5	6	7	8
1. Mood prior to exercise	-	.67*	.72*	.63	.01	.16	-.01	-.14
2. Mood immediately post exercise		-	.91**	.73*	.34	-.37	.15	.31
3. Enjoyment of the exercise bout			-	.74*	.34	-.34	.34	.21
4. Rating of perceived exertion				-	.23	-.34	.39	.22
5. BDI-II score at 6 weeks					-	-.74*	.53	.06
6. DCSES score at 6 weeks						-	-.28	-.22
7. Rumination score at 6 weeks							-	-.10
8. Distraction score at 6 weeks								-

* Correlation significant at $p < .05$.
** Correlation significant at $p < .01$.

Table 6

Correlations Among Mood Variables and Dependent Variables at Time 3.

	1	2	3	4	5	6	7	8
1. Mood prior to exercise	-	.38	-.12	-.26	-.08	.27	-.10	-.53
2. Mood immediately post exercise		-	.74*	.21	-.11	.04	.02	-.35
3. Enjoyment of the exercise bout			-	.56	-.31	.29	-.20	.08
4. Rating of perceived exertion				-	-.39	.52	-.14	.16
5. BDI-II score at 9 weeks					-	-.70*	-.10	-.58
6. DCSES score at 9 weeks						-	-.44	.34
7. Rumination score at 9 weeks							-	.22
8. Distraction score at 9 weeks								-

* Correlation significant at $p < .05$.

CHAPTER FIVE

Discussion

Overall Effect of Exercise on Depression

The first hypothesis predicted that an exercise intervention would be associated with a reduction in depression among clinically depressed women. This hypothesis was supported by the data. All women began the study with "moderate" levels of depression based on their scores on the BDI-II. At the conclusion of the study, the women in the control group were still moderately depressed whereas the women in the exercise intervention group were only minimally depressed. Therefore, a moderate intensity (50-75% HRR) exercise program consisting of 3 exercise sessions per week was associated with a reduction in the symptoms of clinical depression. This finding mirrors the results of numerous previous studies demonstrating a reduction in depression following involvement in an exercise program (Blumenthal et al., 1999; Brown et al., 1992; Dimeo, Baurer, Varahm, Proest, & Halter, 2001; Doyne, Chambless, & Beutler, 1983; Martinsen, Hoffart, & Solberg, 1989; Martinsen, Medhus, & Sandvik, 1985).

The women in the exercise group experienced a significant reduction in their depression by the third week of the study. Ewart (1995) contends that one obstacle to understanding the mechanisms mediating the relationship between exercise and depression is the insistence that mood changes following exercise must be driven by physiological changes such as maximal aerobic capacity, muscular strength, or heart rate. Several studies, such as this one, have found psychological benefits of exercise in short time periods (e.g., Brown et al., 1992; Doyne et al., 1987). Others have also shown small relationships between psychological benefits and physiological changes (Blumenthal et

al., 1999; Doyne et al., 1987; Martinsen, Hoffart, & Solberg, 1989; Veale et al., 1992). However, physiological parameters were not assessed in this study and therefore cannot be ruled out as potential mediators of this relationship. Research indicates that physiological adaptations to training, such as decreased heart rate, reductions in catecholamine response, and attenuation of the slow component of peak O_2 uptake, can occur within the first 2-3 weeks of exercise training (Winder, Hagberg, Hickson, Ehsani, & McLane, 1978; Womack, Davis, Blumer, Barrett, Weltman, & Gaesser, 1995). Therefore, while the reduction in symptoms of depression occurred very rapidly and the focus of this study is on psychological mechanisms, physiological mechanisms remain plausible and should not be discredited.

Women in this study chose the group in which they would participate. As such, it is possible that the women in the two groups differed at study entry on some unmeasured subject characteristic that had an influence on this study outcome. For example, perhaps the women who chose the exercise intervention group had already decided to make a commitment to an exercise program. The Transtheoretical Model of behavior change (Prochaska & DiClemente, 1983) suggests that there are several stages of change that range from "precontemplation" (no intention to start exercising regularly) to "maintenance" (engaging in regular exercise for more than 6 months). This theory predicts that until an individual reaches the "action" stage (immediate intention and commitment to change), she is unlikely to successfully start and maintain an exercise program. Future research should screen study participants to assess their current stage of change. It is possible that an exercise intervention may be most effective for those who have committed to incorporating exercise into their lifestyle. This may also aid

researchers in equalizing groups at study onset and increase the likelihood that participants will adhere to the exercise intervention.

Exercise, Coping Self-Efficacy, and Depression

The second hypothesis examined one of the previously proposed psychological mechanisms, coping self-efficacy. It was predicted that the women in the exercise intervention group would report increased levels of coping self-efficacy. It was also hypothesized that obtained levels of coping self-efficacy would be related to current levels of depression. Both hypotheses were supported by the data. Women in the exercise group had significantly higher coping self-efficacy by the third week of the study and this heightened level of efficacy was maintained throughout the remainder of the study.

The relationship between exercise and coping self-efficacy (rather than generalized feelings of efficacy or efficacy to engage in exercise) has not been previously tested in women suffering from clinical depression. However, research conducted on adults with anxiety disorders supports this finding. Steptoe and colleagues (1989) compared the perceived coping ability of anxious adults following involvement in either an aerobic exercise program or a placebo-control strength and flexibility program. The authors reported that their moderate intensity aerobic exercise program was associated with reductions in anxiety and increases in coping self-efficacy. These psychological benefits were not significantly related to initial fitness level, changes in fitness, or age.

There are several ways in which mastering an important health behavior such as exercise could lead to enhanced feelings to cope with one's depression. First, all the participants were physically sedentary prior to the study. Therefore, making the

commitment to engage in exercise three times per week was a very proactive step in the maintenance of their physical health. Adherence to this program may have increased the womens' awareness that committing themselves to the management of other health behaviors (e.g., proper nutrition, appropriate sleep schedules) could help control the symptoms of their depression. Second, the women were very unfamiliar with the "process" of engaging in an exercise session. During the study, they learned to stretch, monitor heart rate, use exercise equipment, etc. Again, learning and mastering new health-related skills may have given them the confidence necessary to learn to master new techniques to deal with their symptoms. Third, goal setting was promoted throughout the exercise program. As goals were achieved and new goals set, confidence to achieve desired outcomes likely increased. Goal setting may have become viewed as a beneficial self-regulatory strategy to manage depressive symptoms. Fourth, the exercise participants were required to complete one exercise session per week on their own at home. The ability to engage in exercise independent of the group and exercise instructor could have transferred to feelings of confidence to take a more self-managed approach to the control of depressive symptoms. Finally, as the participants began to notice their depression subsiding, they verbalized that their improved affect was due to their involvement in the exercise program. Again, this may have led to the belief that they could, in fact, do something behaviorally that would impact their symptoms and that they weren't simply "victims" of depression.

In this study, coping self-efficacy was the best predictor of depression scores (after controlling for previous levels of depression) among exercise group members at Week 3 and Week 9. Coping self-efficacy demonstrated a negative relationship with

depression indicating that higher levels of efficacy were associated with lower levels of depression. While this does not provide definitive evidence that coping self-efficacy is the psychological mechanism by which exercise exerts a positive influence on depression, it does allude to that possibility and indicates that researchers should continue to study self-efficacy theory in relation to exercise and depression. This finding is in accordance with Bandura's (1997) contention that individuals who feel inefficacious to control their thoughts, feelings, emotions, and reactions are generally more depressed than those with high efficacy.

Therefore, the findings from this study suggest that the enhancement of coping self-efficacy should be an important component in the treatment of depression. Involvement in an exercise program can provided a meaningful mastery experience through which coping self-efficacy can be augmented. If exercise is used as an adjunct therapy in the treatment of this disorder, opportunities for mastery should be emphasized and positive feedback provided.

Exercise, Response Style, and Depression

The third study hypothesis predicted that involvement in an exercise program would be associated with a decreased tendency to use rumination as a response style and an increased use of distraction techniques. Further, it was hypothesized that response style would be associated with symptoms of depression. These hypotheses were partially supported by the data. All women reported a reduced use of ruminative strategies across time, with the exercisers having significantly lower mean scores at Week 3 and at Week 9. Results also indicated that the exercise group members had a higher use of distraction techniques at Week 3 but not at Week 9. Therefore, exercise was associated with a

reduction in the use of rumination across the 9-week study and an increase in the use of a distraction response style at Week 3. However, data did not support the prediction that a response style would be associated with depression among exercise group participants.

No previous studies have examined whether an exercise intervention is associated with a change in response style. Prior research has consistently found that rumination predicts the duration and severity of depressed mood, however, the findings for distraction have been mixed with distraction predicting severity of depression in some studies but not others (Nolen-Hoeksema, 1991). While a positive side effect of exercise may be a more beneficial response style, it does not appear that either rumination or distraction is the psychological mechanism explaining the antidepressant effects of exercise. There are several potential explanations for why response style did not predict depression in the exercise group. With respect to rumination, it is possible that other psychological constructs, such as coping-self-efficacy or social support, may buffer the effects of a ruminative response style in individuals who exercise. Thus, while the person may still have a tendency to use ruminative strategies, if exercise results in increased confidence and a supportive social network, the use of rumination may not have such a negative impact on his/her depression. Nolen-Hoeksema (1991) argues that social support may mediate the relationship between rumination and depression if the social support encourages the depressed individual to stop ruminating and start engaging in distracting activities. Therefore, it is conceivable that exercise group participants may provide this type of social support to each other and help attenuate the effects of rumination on depression. Future research should assess the perceptions of social support among participants.

As for distraction, it remains highly possible that distraction is occurring during exercise activities. Participants may have been temporarily distracted from their depression during each acute exercise bout. If so, that temporary distraction might be responsible for the transient mood elevation that occurred following exercise. Response styles theory predicts that exercise, if an effective distractor, would lead to a temporary elevation in mood which could provide time for more effective problem-solving (Nolen-Hoeksema, Morrow, & Fredrickson, 1993). Therefore, while there was not strong evidence to support a change in response style as the mechanism for reductions in depression, distraction during each exercise bout cannot be ruled out.

It is also possible that an increased use of distracting activities is an important predictor of depression but that such changes were not measured adequately in this study. For example, perhaps exercise leads to an increased use of a variety of distracting activities such as hobbies or various physical activities that were not assessed by the inventory. Or, possibly, a person chooses to use one type of activity that she enjoys as her primary distracting activity. These types of changes would not necessarily be reflected in her distraction score. As Nolen-Hoeksema (1991) discusses, research related to a distractive response style must next find a way to measure the variety of tasks an individual uses to distract him/herself and the degree to which the task demands cognitive involvement. A depressed person may utilize one or two tasks that require much concentration and attention. These would be effective distractors that lead to mood elevation but would not necessarily result in a noticeable change in score on the Distractive Response Style (DRS) subscale. Therefore, an alteration in the use of a distractive response style also remains a possible explanation for the antidepressant

effects of exercise. Future researchers should examine whether participants experience distraction from their thoughts and worries during the exercise bout and whether exercise leads to a change in the type of distracting activities used or the amount of involvement invested in distracting activities. Previous research has only compared the effect of exercise to other distracting activities (Doyne et al., 1983; Klein et al., 1985; McNeil, LeBlanc, & Joyner, 1991), and, as such, findings do not answer those types of questions.

Therefore, an exercise intervention program appears associated with a positive change in response style. If exercise is utilized as an adjunct therapy, participants should be discouraged from discussing their depression during an exercise bout and encouraged to focus on aspects of the program that might provide distraction. Activities such as monitoring heart rate and exercise intensity and engaging in social interaction with other participants should provide distraction from worrisome thoughts and feelings.

Exercise, Mood Elevation, and Depression

As no previous studies were located that had examined acute exercise and mood in the clinically depressed, the examination of the relationships between exercise, mood elevation, and depression was exploratory in nature. Potential mood elevation post-exercise, the length of that mood elevation, and the relationship between transient mood elevation and depression was of interest. There were no formal *a priori* hypotheses related to this area of investigation. Data for exercise group participants indicated that all participants, during all exercise sessions, experienced an elevation in mood following each acute bout of exercise within the 9-week intervention. Further, this mood elevation lasted for the 15 min following each exercise session. Analyses examining changes

across time, while non-significant, showed a trend for increases in pre-exercise mood, post-exercise mood, enjoyment of the exercise bout, and RPE for the exercise bout.

Mood elevation as a result of acute exercise has not been previously studied in clinically depressed participants. Results of this study indicate that depressed individuals engaging in 30 min of moderate intensity exercise experienced mood enhancement following each acute bout similar to those in the general population. Participants rated their mood on a general scale that ranged from "negative, sad, down" to "positive, happy, upbeat". Researchers should next determine if acute exercise has an influence on both the negative and positive dimensions of mood as demonstrated by previous researchers using non-depressed participants (Arent, Landers, & Etnier, 2001; Berger & Owen, 1988; McGowan, Talton, & Thompson, 1996; Petruzzello, Jones, & Tate, 1997; Yeung, 1996). Further, the mechanisms for this mood enhancement remain unknown. As discussed previously, perhaps participants were temporarily distracted from their depression and this led to an improved mood following exercise.

The mood elevation experienced by exercise participants in this study lasted for at least the 15 min following exercise. Mood was only recorded for the 15 min immediately post-exercise and therefore it remains unclear whether this transient elevation in mood actually persisted longer. Solomon's (1980) opponent process theory predicts that the negative feelings associated with exercise should decrease over time and that the length of transient mood elevation should increase across time. The correlational data from this study may provide indirect evidence to support this theory. Across the 9-week intervention, the relationship between RPE and mood shifted from a negative relationship to a positive relationship. Further, early in the intervention, the relationship between RPE

and enjoyment was very small and non-significant. As time progressed, this relationship became much stronger and positive. Therefore, it appears that participants were enjoying the exercise more across time, their mood was enhanced, and, in general, they felt more positive about the exercise bout the harder they perceived themselves to be working.

Petruzzello et al (1991) found partial support for this theory using non-depressed participants. However, it remains uncertain whether pre-exercise affect (which can be quite negative in depressed participants) would alter the expected outcomes as predicted by the theory. Future researchers should examine not only pre and post-exercise mood, but should also try to ascertain what types of feelings the participant is experiencing during the exercise bout. Further, it appears that 15 min is not long enough to adequately assess the length of post-exercise mood. It is possible that mood elevation lasts much longer, as has been demonstrated with the non-depressed (Berger & Owen, 1983; Hanson, Stevens, & Coast, 2001; Maroulakis & Zervas, 1993). Therefore, mood changes in depressed participants should be tracked for several hours post-exercise.

Across time, during the 9-week exercise program, it was anticipated that participants would experience changes in pre-exercise mood, mood immediately post-exercise, enjoyment, and RPE. These findings were non-significant. Although the trends were in the anticipated direction, the effects were small. The participants' mood prior to exercise gradually increased across the three time points analyzed. This may be related to the concurrent reduction in depression that these women were experiencing. The increase in pre-exercise mood however was quite gradual and may also simply reflect the day to day variation in mood that we all experience.

All participants rated mood immediately post-exercise on the positive end of the scale (i.e. from 0 "neutral" to 3 "happy, positive, upbeat") for all exercise sessions. This gradual increase in mood immediately post-exercise may represent greater mood enhancement across time (as predicted by the opponent process theory) or may actually mirror the finding that pre-exercise affect was better across time. Again, more research is needed to examine how mood enhancement changes across time and how long such mood enhancement is expected to last.

Participants' enjoyment of the exercise sessions gradually increased over time as well. Perhaps the exercise became easier which resulted in more enjoyment. Their increased enjoyment of the exercise session could have also resulted from enhanced feelings of mastery. Maybe, as participants became more familiar with the protocol, how to use the exercise equipment, and more confident to complete the exercise session on their own, they enjoyed the exercise more. It is also likely that their enjoyment of the exercise was related to the social nature of the program. As social support was developed and friendships emerged, the participants may have enjoyed the endeavor more.

Rating of perceived exertion also changed minimally across time. Participants reported exercising in the "somewhat hard" to "hard" range and this was expected for a moderate intensity program. Moderate intensity exercise was the target intensity for the 9-week program. Therefore, because exercise intensity did not change across time, large changes in RPE would be unexpected. As participants became more accustomed to exercise and as their depression subsided, they may have felt capable of working more intensely during exercise bouts. Overall, these findings are in accordance with what would be anticipated.

Exploring the relationships among the mood variables and dependent variables resulted in another interesting finding. In the first few weeks of the exercise intervention, there was a strong positive relationship between RPE and depression score. This indicates that the more severe one's depression the higher the rating of effort. Across time, however, this relationship became negative. Therefore, the lower one's depression the higher the effort exerted. This finding could be anticipated considering many individuals with clinical depression experience psychomotor retardation (American Psychiatric Association, 1994). As depression began to subside among exercise group members, symptoms such as psychomotor retardation should have been less severe. Therefore, in the later weeks of the study, the participants probably felt more physically capable of exercise. Dunn et al (2001) called for studies examining effort sense in those suffering from anxiety and depressive disorders. The findings of this study indicate that depressed individuals may initially rate their exertion in relation to their depressive symptoms. However, once their depression begins to subside, it appears that they make exertion judgements independent of the severity of their depression and rate exertion in a manner appropriate to the prescribed exercise intensity.

In summary, many novel findings emerged from these exploratory analyses related to mood. First, depressed individuals do experience mood enhancement following acute bouts of exercise. This mood enhancement can be expected to last for at least 15 min following the exercise. Second, while it does seem that depressed people have realistic perceptions related to effort, ratings of exertion may be influenced by severity of depression and other affective cues early in an exercise program. Finally, the data did not support the idea that these transient changes in mood play a mechanistic role

in the relationship between exercise and depression. Neither pre or post-exercise mood nor enjoyment of the exercise bout were related to depression score at any of the time points analyzed.

Conclusions

There were many important findings that resulted from this study. A moderate intensity exercise program was associated with a reduction in depression among women who were moderately depressed. Further, data provided support for coping self-efficacy as a psychological mechanism for the antidepressant effects of exercise. It also appears that involvement in an exercise program is associated with positive changes in response style. That is, a reduced tendency to ruminate and increased use of a distractive response style. Depressed women experienced transient mood elevation following each acute exercise bout within the chronic exercise program. Therefore, clinicians should be encouraged to utilize exercise as an adjunct therapy in the treatment of clinical depression. Exercise program aspects related to mastery and distraction should be emphasized. Further, clinicians can educate patients that they will likely experience mood enhancement quite early in a group aerobic exercise program and that exercise does not need to be intense for this mood enhancement to occur. Finally, patients should be informed that perceptions of effort may be related to feelings of depression in the early phases of an exercise program but that as time progresses they should feel more physically capable of engaging in exercise and able to put forth increased effort during the exercise bout.

Limitations

There are several limitations to the current study that must be addressed. First, a quasi-experimental design was utilized with participants choosing to be in either the control or exercise group. Therefore, it is possible that these two groups were not equivalent at study entry. Analysis of subject characteristics and study dependent variables indicated that there were no significant differences between groups on variables deemed important. However, there may have been relevant subject characteristics that differed between the two groups that were not assessed in this study.

Second, reductions in depression among exercise group members may have been a result of expectancy effects. Perhaps women in that group expected to feel better because they were engaging in an exercise program. This cannot be excluded as a potential cause for the reductions in depression. However, it seems unlikely that the other positive benefits of exercise that emerged (i.e. increases in coping self-efficacy, reductions in rumination) would have been expected by the participants.

Third, this study did not utilize a placebo-control group. Therefore, the positive benefits associated with the exercise program may have resulted from a "group" effect or from interaction with the investigator. Previous studies that have utilized placebo-control groups have typically found that exercise is still superior in reducing symptoms of depression and not likely due to group effects (Brown et al., 1992; Doyne, Chambless, & Beutler, 1982; Doyne et al., 1987; Singh, Clements, & Fiatarone, 1997). However, results of this study should be interpreted with this limitation in mind. Future research should compare exercise to other "mastery" oriented activities to help determine whether group effects influence the relationship between exercise and depression.

Finally, the small sample size of this study resulted in low statistical power. This could explain several of the non-significant findings. Therefore, before future researchers disregard the theories explored here, it is important to replicate these findings with larger samples. Due to low statistical power, the testing of mediational relationships via path analysis techniques was not possible. While the data provided mixed support for the potential mechanisms examined in this study, each of these mechanisms should be further tested using a larger sample and statistical analyses to address potential mediating relationships.

APPENDIX A

Institutional Review Board Approval and Informed Consent

MICHIGAN STATE
UNIVERSITY

April 16, 2002

TO: Deborah L. FELTZ
138 IM Sports Circle
Dept. of Kinesiology
MSU

RE: **IRB # 02-077** **CATEGORY:** FULL REVIEW FULL REVIEW

TITLE: EXERCISE AND CLINICAL DEPRESSION: EXAMINING PSYCHOLOGICAL MECHANISMS

ANNUAL APPROVAL DATE: **March 11, 2002**
REVISION REQUESTED: March 27, 2002
REVISION APPROVAL DATE: April 1, 2002

The University Committee on Research Involving Human Subjects' (UCRIHS) review of this project is complete and I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the **UCRIHS APPROVED THIS PROJECT'S REVISION.**

Approves the removal of the relaxation group. Consent document revised to reflect this change.

RENEWALS: UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Projects continuing beyond one year must be renewed with the green renewal form. A maximum of four such expedited renewal are possible. Investigators wishing to continue a project beyond that time need to submit it again for a complete review.

REVISIONS: UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB# and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.

PROBLEMS/CHANGES: Should either of the following arise during the course of the work, notify UCRIHS promptly: 1) problems (unexpected side effects, complaints, etc.) involving human subjects or 2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of further assistance, please contact us at (517) 355-2180 or via email: UCRIHS@msu.edu.

Sincerely,

Ashir Kumar, M.D.
Chair, UCRIHS

AK: kj

cc: Lynette Craft
6142 Grossard Avenue
East Lansing, MI 48823

OFFICE OF
RESEARCH ETHICS AND STANDARDS
niversity Committee on Research Involving Human Subjects
Michigan State University
202 Olds Hall
East Lansing, MI
48824
517/355-2180
FAX: 517/432-4503
www.msu.edu/user/ucrihs
E-Mail: ucrihs@msu.edu

Informed Consent

You are invited to participate in a research study examining the relationship between various types of treatment and clinical depression.

This research is being conducted by Lynette Craft of the Department of Kinesiology at Michigan State University (432-4219). This research project is being conducted under the guidance of Dr. Deborah Feltz of Michigan State University (355-4732).

If you elect to be a part of the study, you will be randomly assigned to one of two study groups. You will be asked to either continue with your normal medication treatment for depression or continue with your medication treatment and take part in an exercise training program.

If you are randomly assigned to the medication only group, you will be asked to continue your current medication treatment. Furthermore, you will be asked to complete a series of questionnaires at study entry, 3, 6, and 9 weeks later. These questionnaires are related to your thoughts, feelings, and symptoms of depression and will take approximately 15-20 minutes to complete.

If you are randomly assigned to the medication and exercise group, you will be asked continue your current medication treatment as well as to join a moderate intensity exercise training group. This group will meet twice per week for 45 minutes each session. You will also be asked to complete one 45-min exercise session per week on your own at home. At study entry, 3, 6, and 9 weeks later you will be asked to complete a series of questionnaires related to your thoughts, feelings, and symptoms of depression. This series of questionnaires will take approximately 15-20 minutes to complete. Furthermore, you will be asked to rate your perceived exertion and level of enjoyment for each exercise session as well as your mood immediately prior to, immediately following, and for the 15 minutes after each exercise training session.

All participants who complete the entire 9-week study will receive $25.00 for their participation. Study participants will receive the $25.00 compensation at the end of the study in one payment. Participants who do not complete the entire 9-week study will not be compensated for their involvement.

The primary foreseeable risk to participants in this research study is the mild physical discomfort that can be associated with moderate physical activity.

If you are injured as a result of your participation in this research project, Michigan State University will provide emergency medical care if needed. If the injury is not caused by the negligence of MSU you are personally responsible for the expenses of this medical care and any other medical expenses incurred as a result of this injury.

You are free to withdraw from participating in the study at any time that you feel uncomfortable with the procedure without being penalized in any way. You may refuse to answer certain questions or may discontinue the study at any time without penalty.

If you elect to participate, your responses will be kept confidential and only the research investigators will have access to the data. Only group data will be reported and your name will not be associated with the data in any way. Your privacy will be protected to the maximum extent allowable by law.

If you elect to participate, you will be asked to keep confidential the identities of other study participants.

If you have any questions regarding the study, you are encouraged to ask them at any time, or to contact Dr. Deborah Feltz (355-4732) at any time.

If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the University Committee for Research Involving Human Subjects (UCRIHS): Dr. Ashir Kumar,M.D. at 355-2180.

Your signature below indicates your voluntary decision to participate in this study:

_____

Participant Signature

_____

Date

APPENDIX B

Demographic Questionnaire

Please answer each of the questions below by either filling in the blank or circling the appropriate answer.

Ethnicity
Caucasian
African American
American Indian
Asian American
Latino
Other _____

How old were you when you experienced your FIRST diagnosed episode of depression?
_____

How old were you when you experienced your first self-diagnosed episode of depression? _____

How long has your CURRENT episode of depression lasted? _____

How many times have you been hospitalized for depression? _____

List the medication(s) that you currently take for your depression:
_____

_____

How long have you been taking the above listed medicine(s): _____

List other types of therapy you have tried in the past for your depression such as counseling, ECT therapy, etc.:
_____

_____

Does anyone else in your family have a history of depression? Yes No
If yes, who? _____

Do you have a regular menstrual cycle? Yes No

If you do not have a regular menstrual cycle, are you post-menopausal? Yes No

Please list any current physical health problems. _____

_____

APPENDIX C

Exercise Program Readiness Questionnaire

Michigan State University
Human Energy Research Laboratory
Exercise Program/Testing Readiness Questionnaire

Every participant must fill out this questionnaire and sign a release before he/she will be allowed to participate in an exercise program and/or exercise testing activity sponsored by the Human Energy Research Laboratory. If you are under 18 years of age, a parent or legal guardian must sign the form on your behalf. If you are a man (woman) over 40 (50), or under 40 (50) and physically inactive, your physician must also sign this form indicating your ability to participate in the exercise program or test indicated.

Name _____ Phone _____ Date _____

Address _____ Date of Birth _____

Ht _____ Wt _____

_____Yes _____No	1. Has your doctor ever said you have heart trouble?
_____Yes _____No	2. Have you ever had chest pain or heavy pressure in your chest as a result of exercise, walking, or other physical activity, such as climbing a flight of stairs? (Note: This does not include normal out-of-breath feeling that results from vigorous exercise)
_____Yes _____No	3. Do you often feel faint or experience severe dizziness?
_____Yes _____No	4. Has a doctor ever told you that you have high blood pressure or diabetes?
_____Yes _____No	5. Have you ever had a real or suspected heart attack or stroke?
_____Yes _____No	6. Do you have nay physical condition, impairment or disability including any joint or muscle problem, that should be considered before you undertake an exercise program?
_____Yes _____No	7. Have you ever taken medication to reduce your blood pressure or cholesterol levels?
_____Yes _____No	8. Are you excessively overweight?
_____Yes _____No	9. Is there any good physical reason not mentioned here why you should not follow an exercise program even if you wanted to?
_____Yes _____No	10. Are you over age 40, or not accustomed to vigorous exercise?

If you answered YES to one or more questions, and if you have not recently done so, consult with your physician BEFORE entering an exercise program or participating in an exercise test. After medical evaluation or consultation, have your physician sign this form indicating your suitability for the following activity:

_____

_____

_____ _____ _____
Signature of Physician Date Phone

APPENDIX D

Beck Depression Inventory-II

ID # _____

BDI-II

This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the **one statement** in each group that best describes the way you have been feeling during the **past two weeks, including today**. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleeping Pattern) or Item 18 (Changes in Appetite).

1. Sadness
   0 I do not feel sad.
   1 I feel sad much of the time.
   2 I am sad all the time.
   3 I am so sad or unhappy that I can't stand it.

2. Pessimism
   0 I am not discouraged about my future.
   1 I feel more discouraged about my future than I used to be.
   2 I do not expect things to work out for me.
   3 I feel my future is hopeless and will only get worse.

3. Past Failure
   0 I do not feel like a failure.
   1 I have failed more than I should have.
   2 As I look back, I see a lot of failures.
   3 I feel I am a total failure as a person.

4. Loss of Pleasure
   0 I get as much pleasure as I ever did from the things I enjoy.
   1 I don't enjoy things as much as I used to.
   2 I get very little pleasure from the things I used to enjoy.
   3 I can't get any pleasure from the things I used to enjoy.

5. Guilty Feelings
   0 I don't feel particularly guilty.
   1 I feel guilty over many things I have done or should have done.
   2 I feel quite guilty most of the time.
   3 I feel guilty all of the time.

6. Punishment Feelings
   0 I don't feel I am being punished.
   1 I feel I may be punished.
   2 I expect to be punished.
   3 I feel I am being punished.

7. Self-Dislike
   0 I feel the same about myself as ever.
   1 I have lost confidence in myself.
   2 I am disappointed in myself.
   3 I dislike myself.

8. Self-Criticalness
   0 I don't criticize or blame myself more than usual.
   1 I am more critical of myself than I used to be.
   2 I criticize myself for all of my faults.
   3 I blame myself for everything bad that happens.

9. Suicidal Thoughts or Wishes
   0 I don't have any thoughts of killing myself.
   1 I have thoughts of killing myself, but I would not carry them out.
   2 I would like to kill myself
   3 I would kill myself if I had the chance.

10. Crying
   0 I don't cry anymore than I used to.
   1 I cry more than I used to.
   2 I cry over every little thing.
   3 I feel like crying, but I can't.

11. Agitation
   0 I am no more restless or wound up than usual.
   1 I feel more restless or wound up than usual.
   2 I am so restless or agitated that it's hard to stay still.
   3 I am so restless or agitated that I have to keep moving or doing something.

12. Loss of Interest
   0 I have not lost interest in other people or activities.
   1 I am less interested in other people or things than before.
   2 I have lost most of my interest in other people or things.
   3 It's hard to get interested in anything.

13. Indecisiveness
    0 I make decisions about as well as ever.
    1 I find it more difficult to make decisions than usual.
    2 I have much greater difficulty in making decisions than I used to.
    3 I have trouble making any decisions.

14. Worthlessness
    0 I do not feel I am worthless.
    1 I don't consider myself as worthwhile and useful as I used to.
    2 I feel more worthless as compared to other people.
    3 I feel utterly worthless.

15. Loss of Energy
    0 I have as much energy as ever.
    1 I have less energy than I used to have.
    2 I don't have enough energy to do very much.
    3 I don't have enough energy to do anything.

16. Changes in Sleeping Pattern
    0 I have not experienced any change in my sleeping pattern
    1a I sleep somewhat more than usual.
    1b I sleep somewhat less than usual.
    2a I sleep a lot more than usual.
    2b I sleep a lot less than usual.
    3a I sleep most of the day.
    3b I wake up 1-2 hours early and can't get back to sleep.

17. Irritability
    0 I am no more irritable than usual.
    1 I am more irritable than usual.
    2 I am much more irritable than usual.
    3 I am irritable all the time.

18. Changes in Appetite
    0 I have not experienced any change in my appetite.
    1a My appetite is somewhat less than usual.
    1b My appetite is somewhat greater than usual.
    2a My appetite is much less than before.
    2b My appetite is much greater than before.
    3a I have no appetite at all.
    3b I crave food all the time.

19. Concentration Difficulty
    0 I can concentrate as well as ever.
    1 I can't concentrate as well as usual.
    2 It's hard to keep my mind on anything for very long.
    3 I find I can't concentrate on anything.

20. Tiredness or Fatigue
    0 I am no more tired or fatigued than usual.
    1 I get more tired or fatigued more easily than usual.
    2 I am too tired or fatigued to do a lot of the things I used to do.
    3 I am too tired or fatigued to do most of the things I used to do.

21. Loss of Interest in Sex
    0 I have not noticed any recent change in my interest in sex.
    1 I am less interested in sex than I used to be.
    2 I am much less interested in sex now.
    3 I have lost interest in sex completely.

APPENDIX E

Depression Coping Self-Efficacy Scale

The following measure describes coping activities that may be helpful in treating the symptoms of depression. Under the column headed **CONFIDENCE**, mark how confident you are that you could do each activity using a number from 0 to 10. These numbers mean that you are not at all confident or sure (0) to completely confident or sure (10) that you can do each of these things listed. You may use any number from 0-10.

0 1 2 3 4 5 6 7 8 9 10
Not confident Moderately confident Confident

I am this confident that I will be able to do the following things that may relive or prevent the symptoms of depression:

	Confidence (Mark 0-10) ↓
Tell others how I feel in a socially acceptable manner	_____
Be aware of my behavior and how it affects others	_____
Refuse requests of others when I do not wish to do something that someone else wants me to do, including authority figures and strangers	_____
Go to bed and get up at the same time every day	_____
Plan pleasant things to do for my free time	_____
Limit naps to 20-30 minutes during the day	_____
Ask for help when I am having trouble understanding something because I am not concentrating well (like income tax, legal documents, etc.)	_____
Eat four servings of fruits and vegetables daily	_____
Drink 6 to 8 glasses of water daily	_____
Recognize when I am blaming myself for my symptoms and try to stop	_____
Engage in some sort of creative activity like writing, reading, drawing, playing music, or working on projects	_____
Get together with at least one very close person when I am feeling lonely	_____

0 1 2 3 4 5 6 7 8 9 10
Not confident Moderately confident Confident

I am this confident that I will be able to do the following things that may relive or prevent the symptoms of depression:

Confidence (Mark 0-10)
↓

Get up and do something relaxing if I cannot sleep, before trying again _____

Question whether it is reasonable to think this way each time I think about myself in a negative way or assume that I am no good _____

Take a bath or do some other soothing activity before bedtime _____

Take medication the way my doctor recommends _____

Exercise or do some active thing every day _____

Be aware of when I am thinking about myself in a negative way or assuming that I am no good _____

Laugh and try to find humor in my situation, in spite of my problem _____

Challenge the thought that suicide is the only way I can deal with my problems _____

Attempt to understand why I am anxious when I have anxiety _____

Keep a journal describing my mood or how I feel emotionally each day _____

Meditate or do relaxation exercises at least once a day _____

Become aware of those feelings that bother me so I can work on not letting them bother me _____

APPENDIX F

Response Styles Questionnaire

Responses to Depression

People think and do many different things when they feel depressed. Please read each of the items below and indicate whether you never, sometimes, often, or always think or do each one when you feel down, sad, or depressed. Please indicate what you *generally* do, not what you think you should do.

Almost Never	Sometimes	Often	Almost Always	
❑	❑	❑	❑	think about how alone you feel
❑	❑	❑	❑	think "I won't be able to do my job/work because I feel so badly
❑	❑	❑	❑	think about your feelings of fatigue and achiness
❑	❑	❑	❑	think about how hard it is to concentrate
❑	❑	❑	❑	try to find something positive in the situation or something you learned
❑	❑	❑	❑	think "I'm going to do something to make myself feel better"
❑	❑	❑	❑	help someone else with something in order to distract yourself
❑	❑	❑	❑	think about how passive and unmotivated you feel
❑	❑	❑	❑	remind yourself that these feelings won't last
❑	❑	❑	❑	analyze recent events to try to understand why you are depressed
❑	❑	❑	❑	think about how you don't seem to feel anything anymore
❑	❑	❑	❑	think "Why can't I get going?"
❑	❑	❑	❑	think "Why do I always react this way?"
❑	❑	❑	❑	go to a favorite place to get your mind off your feelings
❑	❑	❑	❑	go away by yourself and think about why you feel this way

Almost Never	Sometimes	Often	Almost Always	
❑	❑	❑	❑	write down what your are thinking about and analyze it
❑	❑	❑	❑	do something that has made you feel better in the past
❑	❑	❑	❑	think "I'm going to go out and have some fun"
❑	❑	❑	❑	concentrate on your work
❑	❑	❑	❑	think "Why do I have problems other people don't have?"
❑	❑	❑	❑	think about how sad you feel
❑	❑	❑	❑	think about all your shortcomings, failings, faults, mistakes
❑	❑	❑	❑	do something you enjoy
❑	❑	❑	❑	think about how you don't feel up to doing anything
❑	❑	❑	❑	do something fun with a friend
❑	❑	❑	❑	analyze your personality to try to understand why you are depressed
❑	❑	❑	❑	go someplace alone to think about your feelings
❑	❑	❑	❑	think about how angry you are with yourself
❑	❑	❑	❑	listen to sad music
❑	❑	❑	❑	isolate yourself and think about the reasons why you feel sad
❑	❑	❑	❑	try to understand yourself by focusing on your depressed feelings

APPENDIX G

Rating of Perceived Exertion Scale

Perceived Exertion

6

7 Very, very light

8

9 Very light

10

11 Fairly light

12

13 Somewhat hard

14

15 Hard

16

17 Very hard

18

19 Very, very hard

20

APPENDIX H

Rating of Mood and Enjoyment of Exercise Scales

Study Week _____ Session _____ ID #_____

I. Please rate your current mood on the scale below. You should focus on how you feel right now for the time indicated.

Immediately prior to exercise session:

Very negative, Sad, Down			Neutral			Very good, Happy, Upbeat
-3	-2	-1	0	1	2	3

Immediately following the exercise session:

Very negative, Sad, Down			Neutral			Very good, Happy, Upbeat
-3	-2	-1	0	1	2	3

5 minutes following the exercise session:

Very negative, Sad, Down			Neutral			Very good, Happy, Upbeat
-3	-2	-1	0	1	2	3

10 minutes following the exercise session:

Very negative, Sad, Down			Neutral			Very good, Happy, Upbeat
-3	-2	-1	0	1	2	3

15 minutes following the exercise session:

Very negative, Sad, Down			Neutral			Very good, Happy, Upbeat
-3	-2	-1	0	1	2	3

II. Rating of enjoyment

Using the scale below, please rate how much you enjoyed the exercise session you just completed

Not at all			Somewhat			Very much so
-3	-2	-1	0	1	2	3

III. Rating of Perceived Exertion (RPE)

Please rate your average RPE for the exercise session: _____

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BIBLIOGRAPHY

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