THE EFFECTS OF PERFORMANCE FEEDBACK ON EXERCISE, PHYSIOLOGICAL REACTIVITY, AND AFFECTIVE STATE AMONG HOSTILE COLLEGE STUDENTS

by

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ABSTRACT

The Effects of Performance Feedback on Exercise, Physiological Reactivity, and Affective State among Hostile College Students

by

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Hostility has been found to be a risk factor for cardiovascular disease. One proposed pathway between hostility and cardiovascular disease is an increase in cardiovascular reactivity among hostile individuals when faced with challenging, competitive situations, in which interpersonal stressors are present. A potential situation that may elicit this exaggerated reactivity is found in cardiac rehabilitation exercise programs. Such factors may be competition and feedback regarding their performance. This study sought to find out how hostile individuals would respond physiologically, behaviorally, and affectively when presented with negative and positive performance feedback, while exercising in a challenging, competitive setting. It was found that the three groups (positive feedback, negative feedback, no feedback) did not differ on physiological reactivity, exercise behavior, or affect as a result of the type of feedback they received. Limitations of the study are discussed and
improvements for future studies are suggested.
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1. Interaction effects of group and time for rating of perceived exertion
CHAPTER I
INTRODUCTION AND PROBLEM STATEMENT

A standard rehabilitation regimen for persons who have undergone heart surgery or suffered from a heart attack is to participate in a structured exercise program. It is well documented that exercise has beneficial effects on one’s physical and mental health (Sallis & Owen, 1999). A typical exercise rehabilitation program involves exercising in a group setting and receiving periodic feedback from a professional regarding exercise performance (Oldridge, Guyatt, Rischer, & Rimm, 1988). For some individuals, the presence of others exercising simultaneously may be a stimulus for competitive performance.

Research has shown that hostility is a common characteristic of individuals who have suffered from a heart condition (Barefoot, Dahlstrom, & Williams, 1983). Competition has been found to be related to hostility (Felsten, 1995), and competitiveness may, very likely, characterize cardiovascular patients as well. Hence, given that individuals who participate in a standard exercise rehabilitation program are likely to be hostile and competitive and are put in an environment in which competition may be inferred and feedback is regularly given, negative emotional, physiological, and behavioral reactivity may be elicited. Thus, it is important to study affective, physiological, and behavioral responses induced by competition and feedback in the context of exercise in a sample of hostile people. Therefore, this study investigated the effect different types of exercise performance feedback had on hostile individuals’ affect,
physiological reactivity, and behavioral response. The particular conditions of this study provided participants with negative, positive, or no feedback.

Eighty-two hostile college students participated in this study. The choice of this population in a study of exercise, affect, and cardiovascular reactivity, implicating the relations among cardiovascular diseases, exercise environment, and hostility, is supported by research findings on the development of cardiovascular diseases in childhood and adolescence. For example, Matthews and Woodall (1988) found that the development of atherosclerosis begins in late adolescence. Early signs of a heart condition, including the relation between hostility and heightened physiological reactivity, may be detected in young adults (Matthews & Woodall; McCann & Matthews, 1988). A study that used the Cook-Medley Hostility Inventory with 18-30 year-olds found association between high hostility scores and coronary artery calcification, a maker of subclinical atherosclerosis (Iribarren et al., 2000). Still another study that used the Cook-Medley Hostility Inventory found that the scores obtained in college explained half of the variance 23 years later when the same individuals were retested (Siegler et al., 1990). The authors also suggested that the 20s might be the best age to identify those whose personality traits may put them at risk for the development of disease and to prevent such a development. They further indicated that hostility during the college years might predispose a person to CHD, regardless of later development in personality. A meta-analysis also found hostility to be more strongly associated with CHD (CHD) in younger participants than in older ones (Miller, Smith, Turner, Guijarro, & Hallet, 1996). Because the development of cardiovascular diseases often begins in adolescence and because hostility is a stable
trait among adolescents (Woodall & Matthews, 1993) and among adults (e.g., Shekelle, Gale, Ostfeld, & Paul, 1983), it makes sense to examine hostile college students and implicate the findings in terms of risks for cardiovascular disease.

Thus, this study explored the effect of different types of performance feedback on hostile college students’ affect, physiological reactivity, and behavior. The findings of this study will be generalized only to other hostile college students. However, the results may also provide information leading to investigations with other populations and situations in which hostile persons are participants and competition and exercise performance feedback are present. Some such populations may be professional and student athletes and persons in cardiac rehabilitation programs.

Research Questions

The following questions are of interests in this study:

1. What effect does negative, positive, or no performance feedback have on hostile persons’ affect while exercising under competitive conditions?

2. What effect does negative, positive, or no performance feedback have on hostile persons’ perceived exertion while exercising under competitive conditions?

3. Will positive and negative evaluation in the form of performance feedback change the level of effort hostile persons put forth when they exercise?

4. What effect does negative, positive, or no performance feedback have on hostile persons’ physiological reactivity while exercising under competitive conditions?
Hypotheses

In light of the literature, it was hypothesized that the way the participants exercise, their affect, and cardiovascular reactivity would change according to the type of feedback they received regarding their exercise performance in the following ways. Specifically, the affect of those individuals in the no feedback condition should become more positive as a result of exercise alone. The affect of those who received positive feedback would be more positive postexercise due to both the effect of exercise and the positive feedback. Although the affect of those in the negative feedback condition may become more positive as a result of exercise as well, it is hypothesized that the negative feedback would make the exercise session unpleasant and lead to more negative affect than would be found in the other two groups. It was hypothesized that ratings of perceived exertion, another indicator of affect, would be higher for those in the negative feedback condition, lower for those in the positive, and similar for those in the no feedback condition between the prefeedback and the postfeedback parts of the exercise session. Those who received no feedback would not change the way they exercise. Those who received positive feedback most likely would continue to exercise in the same way. Those who received negative feedback would exercise harder in order to perform better. In terms of cardiovascular reactivity, there would be a gradual increase in heart rate and blood pressure during the exercise. Those who received positive feedback would experience similar cardiovascular reactivity as those who receive no feedback. Those who received negative feedback would experience a greater increase in blood pressure and heart rate than those in the other two conditions.
CHAPTER II
REVIEW OF THE LITERATURE

This review of literature will cover the following topics: the importance of exercise in the prevention and rehabilitation of cardiovascular diseases; the benefits of exercise on mental health; the relation between hostility and cardiovascular diseases; the mechanisms behind the relation between hostility and cardiovascular diseases; hostility and competition; hostility and exercise in competitive and evaluative conditions; and how different types of feedback affect one’s affect, physiological reactivity, and behavior.

Exercise and Cardiovascular Diseases

Evidence of the importance of exercise on the prevention of and recovery from cardiovascular diseases, the most common cause of death in the world (U.S. Department of Health and Human Services, 1996), is extensive in the literature. Twelve epidemiological studies have shown that physical activity and fitness reduce risk of and deaths from cardiovascular diseases (USDHHS, 1996). For example, men who were unfit at baseline but increased their fitness later were compared with men who were unfit at baseline, but did not increase their fitness. Those who increased their fitness later were found to reduce their risk of mortality from cardiovascular diseases by 52% and from risk of all-cause mortality by 44% (Blair et al., 1995). A meta-analysis of ten studies of cardiac rehabilitation programs that included exercise as a major component had a reduction of 24% on all-cause death and 25% on cardiovascular death (Oldridge et al., 1988).
The lack of physical activity or sedentary living is associated with CHD, the most deadly form of cardiovascular disease. A meta-analysis found that the least active or fit study participants had an 80% higher risk of dying from CHD than the most active or fit group (Berlin & Colditz, 1990). It is estimated that 35% of deaths from coronary diseases can be attributed to sedentary living (USDHHS, 1996).

Physical inactivity has also been associated with hypertension. For example, active women have been shown to be 30% less likely than sedentary women to develop hypertension (Folsom, Prineas, Kaye, & Munger, 1990). Men who participated in vigorous sports reduced their risk of developing hypertension by as much as 30% (Paffenbarger, Wing, Hyde, & Jung, 1983).

Physical fitness is associated with various physiological factors that lower the risk for cardiovascular disease (Sallis & Owen, 1999). For example, aerobic exercise reduced hypertensive patients' systolic and diastolic blood pressures by about 6 to 7 mm Hg (Kelley & McClellan, 1994). Even a single episode of physical activity leads to a temporarily lowering of blood pressure by dilating blood vessels, whereas long-term exercise lowers blood pressure by reducing sympathetic nervous system activation (Sallis & Owen). Individuals who had regular exercise were more likely to have lower triglyceride and resting heart rate and higher high density lipoprotein (HDL) cholesterol (Mahanonda et al., 2000).

Exercise and Mental Health

Physical activity not only reduces risk of and death from cardiovascular disease
but it also has psychological benefits. Many studies have shown that exercise has a positive effect on one’s mental health. For example, Gauvin, Rejeski, and Norris (1996) found that acute physical activity improved one’s feeling state, such as feelings of revitalization, positive affect, positive engagement, and tranquility, and decreased negative affect. Both long-term regular exercise and short-term exercise are effective in reducing negative mood states. The former has been associated with lower scores on negative affect, such as hostility, trait anxiety, and aggression (Nouri & Beer, 1989), and the latter, such as a single aerobic exercise session, is sufficient in decreasing negative affective states, such as depression, tension, and confusion (Barabasz, 1991). Hansen, Stevens, and Coast (2001) found that 10 min of exercise at an aerobic level of 60% was sufficient to increase vigor, and decrease fatigue, confusion, and total negative mood state among college females. Studies have shown that anxiety can be reduced by exercise (e.g., Landers & Petruzzello, 1994), and the effect may last 2 to 4 hours (Raglin, 1990). A study found that although both exercise and quiet rest lead to a reduction in blood pressure and state anxiety, exercise was able to produce a longer lasting effect on anxiety and reduction in blood pressure (Raglin & Morgan, 1987). Another study by Rejeski, Thompson, Brubaker, and Miller (1992) showed that vigorous exercise leads to an improvement in one’s ability to cope with stress, both physiologically and psychologically. Because the cardiovascular system is highly responsive to stress, as reflected by elevated blood pressure and increased heart rate, such an effect of vigorous exercise on one’s ability to cope with stress is highly meaningful.
Exercise exerts an influence on the prevention of and recovery from cardiovascular disease through physical and emotional effects. Thus, due to the favorable relation between physical activity and cardiovascular disease, exercise is a major component of cardiac rehabilitation programs.

Hostility

The Type A behavior pattern, characterized by competitiveness, achievement orientation, a sense of time urgency, impatience, aggressiveness, and hostility, has long been associated with CHD (Friedman & Rosenman, 1974). However, it has been found that hostility, a component of the Type A personality, is the most “toxic” element of the Type A Behavior Pattern, or the main predictor of heart disease (e.g., Barefoot et al., 1983; Shekelle et al., 1983; Williams et al., 1980). Specifically, Williams et al. (1980) found the Type A behavior pattern and hostility to be independently related to coronary atherosclerosis, with the latter having a stronger relation than the former. Barefoot and colleagues’ (1983) examination of the relation between the health status of a group of 255 physicians and their hostility scores on the MMPI taken 25 years ago when the physicians were medical students found that high hostility scores were predictive of both clinical coronary disease incidence and total mortality.

More recent studies have also found an association between hostility and cardiovascular diseases. A longitudinal study showed that higher hostility scores during late adolescence were associated with greater caffeine consumption, a larger body mass index, smoking, a larger lipid ratio, and more hours of exercise, all of which, except the
last, are risk factors for CHDs (Siegler, Peterson, Barefoot, & Williams, 1992). A review of risk factors for CHD in children and adolescents found that risk factors, such as high blood pressure, physiological reactivity, high lipid level, anger, and hostility begin well before adulthood, and that hostility was correlated with some of these risk factors (Grunbaum, Vernon, & Clasen, 1997). Even after associated factors, such as smoking and alcohol consumptions were controlled, hostility remained as an independent risk factor for CHD (Miller et al., 1996). Other studies have found cardiac patients to have higher hostility scores than healthy controls (Atchison & Condon, 1993). Hostility has also been found to be related to a greater risk for the development of coronary artery disease (Dembroski, MacDougall, Costa, & Grandits, 1989) and to be predictive of future restenosis or reclogged arteries after percutaneous transluminal coronary angioplasty (Goodman, Quigley, Moran, Meilman, & Sherman, 1996). Hostility has also been found to be associated with silent left ventricular dysfunction (Burg, Jain, Soufer, Kerns, & Zaret, 1993). Another study found that early ischaemic heart disease is more common in chronically hostile people (Ketterer et al., 2000). A reduction in hostility, along with other negative traits and states, resulting from participation in cognitive/behavioral treatment led to a 37% decline in cardiac events (nonfatal myocardial infarction or cardiac death) in another study (Friedman et al., 1984, 1987).

Hostility is a multidimensional construct that has been defined in many ways and has been measured by both self-report inventories and interviews. The Structured Interview, used to assess the Type A behavior pattern, measures the "potential for hostility," which is conceptualized as
a stable predisposition to respond to a relatively broad range of frustrating circumstances with varying degrees and combinations of anger, irritation, disgust, arrogance, contempt, resentment, and the like, which may or may not be associated with overt behavior directed against the source of the frustration. (MacDougall, Dembroski,Dimsdale, & Hackett, 1985, pp. 140-141)

Some of the best-known and most widely used self-report measures of hostility are the Cook and Medley Hostility Inventory (Ho; Cook & Medley, 1954) and the Buss-Durkee Hostility Inventory (Buss & Durkee, 1957). The Ho measures a specific type of hostility, which is characterized by a sense of mistrust of persons, resentment, and cynicism. Persons who score high on the Ho are those who dislike and distrust others, see people as "dishonest, unsocial, immoral, ugly and mean and believe they should be made to suffer for their sins. Hostility amounts to chronic hate and anger" (pp. 414-418). They are also likely to view their interpersonal world as "an irritating struggle that requires vigilance" (Smith & Frohm, 1985, p. 510). Although they are likely to experience anger often, they are not necessarily likely to be overtly aggressive. Because of its association with chronic suspiciousness and mistrust, hostility measured by the Ho is thus termed "cynical hostility" by some researchers (Smith & Frohm). Some factor analyses of the scale have found the presence of two factors, "cynicism" and "paranoid alienation" (Costas, Zonderman, McCrae, & Williams, 1986).

The Buss-Durkee Hostility Inventory consists of eight subscales: assault, indirect hostility, irritability, negativism, resentment, suspicion, verbal hostility, and guilt. Factor analyses revealed two factors: an "attitudinal" component and a "motor" component (Buss & Durkee, 1957). Bendig's (1962) factor analysis of the Buss-Durkee also found
two factors: overt and covert hostility, whereas Russell (1981) found three different factors: neuroticism, general hostility, and expression of anger.

Mechanisms Linking Hostility and Cardiovascular Diseases:
Cardiovascular Reactivity and Psychological Distress in Challenging, Competitive Situations

Various models have been proposed to explain the relation between hostility and cardiovascular diseases (for a review, see Smith, 1992). Of the different models, the psychophysiological reactivity model and transactional model are of most significance in the proposed study.

The psychophysiological reactivity model states that hostile persons tend to display heightened cardiovascular and neuroendocrine reactivity, compared with nonhostile persons, and thus, may be at a higher risk for cardiovascular diseases due to their heightened psychophysiological states. The model suggests that due to their proneness to anger, hypervigilance, and the feeling of not having control (Prkachin, Mills, Kaufman, & Carew, 1991), hostile people display more pronounced increases in blood pressure, heart rate, and stress-related hormones in response to potential stressors than nonhostile persons. This exaggerated physiological reactivity is thought to contribute to the development and worsening of cardiovascular diseases (e.g., Suarez & Williams, 1989; Williams, Barefoot, & Shekelle, 1985).

The transactional model, a recently constructed but potentially prominent model in explaining the mechanisms behind hostility and cardiovascular diseases, proposes that
hostile persons do not simply respond to stress in the environment with heightened physiological reactivity, but they create their own stressors and conflict through their thoughts and actions, which in turn, shape their personality or their individualistic, characteristic ways of thinking and behaving, which may be physically and psychologically taxing (Smith & Anderson, 1986; Smith & Frohm, 1985; Smith & Pope, 1990). The environment they create or find themselves in reinforces their personality and behaviors. Smith (1995) proposed that hostility may be resulting from hostile individuals’ view that others are untrustworthy and in competition (Price, 1982), their attempt to maintain control over the environment (Smith & Brown, 1991), feelings of insecure self-worth, and a desire to exert control and dominance over others (e.g., Powell, 1992; Price, 1982).

Evidence supporting the two models can be found in numerous studies. For example, high Ho scores have been found to be related to heightened psychophysiological responses to interpersonal conflict (Houston, 1994; Suarez & Williams, 1989) and self-disclosure (Christensen & Smith, 1993). Cynical hostile persons, compared to those who are not cynical hostile, report more interpersonal stressors (Smith, Pope, Sanders, Allred, & O’Keeffe, 1988), and respond to interpersonal conflict with greater increases in diastolic blood pressure (Hardy & Smith, 1988). Men with high Ho scores showed exaggerated cardiovascular arousal when harassed during an anagram task (Suarez & Williams). Performing the anagram task without harassment did not lead to heightened cardiovascular reactivity. On the other hand, even though men with low Ho scores did exhibit anger and irritation, they did not exhibit heightened
cardiovascular reactivity. The authors suggest that hostility alone may not directly lead to heightened physiological reactivity, but a challenging, stressful situation involving interpersonal social conflicts must be involved. Engebretson and Matthews (1992) found that hostile men exhibited elevated systolic blood pressure in response to “standardized laboratory stressors” or cognitive and motor tasks that have been used psychophysiological studies of cardiovascular responses to psychological stress. Type A’s with particularly high hostile/competitive scores respond to both high and low challenge conditions equally with high systolic blood pressure and heart rate elevation, whereas globally defined Type A’s respond with heightened physiological reactivity only under high challenges. This may be due to this population’s perception of mildly challenging or even low challenging situations as very challenging (Dembroski, MacDougall, Herd, & Shields, 1979). Hostile persons tend to judge themselves to have less control than nonhostile persons, and this sense of lack of control is associated with increased heart rate. On the other hand, increasing the participants’ sense of control decreased heart rate (Prkachin et al., 1991). Pope and Smith (1991) found that individuals with high hostility scores had higher urinary cortisol excretion during routine daily activities than those with low hostility scores.

It appears that the setting or the type of task involved is crucial to the type of response exhibited by individuals high on hostility. Psychological/interpersonal stressors and challenging competitive situations seem to be the key to heightened physiological reactivity among hostile persons. Psychological/interpersonal stressors lead to heightened cardiovascular reactivity among hostile individuals. However, mental tasks,
(such as mental arithmetic, Stroop task, cold pressor) that do not involve psychological/interpersonal stressors have generally not have been found to lead to this response (e.g., Sallis, Johnson, Treverrow, Kaplan, & Hovell, 1987; Smith & Houston, 1987). Physical stressors may also lead to heightened cardiovascular reactivity. A study found that adolescents high on potential for hostility, as assessed by the structured interview, showed greater systolic blood pressure changes during a handgrip task than adolescents low on potential for hostility (McCann & Matthews, 1988).

The relationship between hostility and cardiovascular disease may be linked by the experience of anger in that hostile persons will be likely to experience anger more frequently and intensely than those low in hostility. That is, anger and hostility often are positively correlated. For example, a review (Spielberger et al., 1991) of the studies done on the relations between hypertension, anger, and anxiety concluded that hypertensive individuals respond with intense anger more frequently than normotensive persons when evaluated negatively or perceiving themselves as being treated unfairly. The former also experience more anger, hostility, and anxiety, but are less likely to express anger. A study found high hostile people experiencing greater anger, frustration, and annoyance than nonhostile people involving a competitive interpersonal task (Felsten, 1995), even though their cardiovascular reactivity did not differ. Hostile individuals in another study reported greater anger and evaluated their competitors more negatively during a hostile, competitive reaction time task (Pope, Smith, & Rhodewalt, 1990).

Although a few studies have failed to find the association between hostility and heightened cardiovascular reactivity in response to psychological stress (e.g., Diamond et
al., 1984; Glass, Lake, Contrada, Kehow, & Erlanger, 1983), the majority of the studies have found such an association. Given hostile individuals' tendency to view others and challenging situations negatively, experience anger and other negative affect, and react with heightened physiological reactivity, it is postulated that challenging situations, such as exercising in a competitive setting and receiving negative exercise performance evaluation, would also produce perceptions of challenge, negative affect, and heightened physiological activity among hostile individuals.

Hostility and Competition

The relation between hostility and competition is that hostile persons tend to be competitive and that competitive situations elicit hostility and other negative affect among hostile persons. A study found hostile style to be associated with a tendency to be competitive, hard-driving, and time-pressured among men, as assessed by pencil-and-paper measures (Engebretson & Matthews, 1992). Competitive situations may elicit negative feelings among hostile persons more than they do among nonhostile ones. For example, Felsten (1995) found high hostile people experiencing greater anger, frustration, and annoyance than nonhostile people involving a competitive interpersonal task. Another study found that hostile individuals reported greater anger and evaluated their competitors more negatively during a hostile, competitive reaction time task (Pope, et al., 1990). Aside from eliciting negative affect, competition also leads to increased cardiovascular reactivity. Studies have shown that Type A individuals, who are likely to
be hostile as well, exhibit this heightened response in challenging, competitive settings more than Type B persons (e.g., Glass et al., 1980).

Hostility and Exercise in Competitive and Evaluative Conditions

Little is known about the relationship between hostility and exercise in competitive and evaluative settings. Although exercise typically leads to positive affect, positive affect may not be experienced when exercising in competitive and evaluative exercise conditions, especially when the interaction between the individual’s personality and the exercise environment is taken into consideration. Studies have found that, in general, exercise in a noncompetitive environment leads to more positive affect than in a competitive environment (e.g., Masters, LaCaille, & Shearer, In Press). Competition in sports is generally considered to be an acute stress (e.g., McKay, Selig, Carlson, & Morris, 1997). Berger and Owen (1983) suggest that activities that are aerobic, noncompetitive, predictable, and rhythmical tend to produce greater psychological benefit than those that are not. Among Type A’s Masters et al. found that exercising in a competitive condition produced less positive affect than exercising in a noncompetitive condition. Aside from having a negative impact on one’s psychological and emotional state, competition also affects one’s physiological state. For example, studies have found heightened cardiovascular reactivity among golfers during competition, compared to during practice (McKay et al.).

Relating the exercise environment to cardiac rehabilitation exercise programs, such factors as competition and evaluation that may be present in these programs may
partly explain the low adherence to exercise among cardiac patients, despite its benefits on physical and potentially mental health. That is, the condition in which one exercises and the personality traits of the participants (e.g., hostility) may both have significant impact on recovery and exercise adherence. Specifically, those who exercise under unfavorable conditions not only may not benefit from exercising, but may suffer from it instead. A probable example involving a competitive and evaluative situation is that of hostile individuals exercising in a cardiac exercise rehabilitation program and experiencing negative affect due to the presence of others exercising, and thus, creating, in these susceptible people, the perception of competition against others in the program and being evaluated on their performance. In light of what is known about hostile persons' attitude towards others and the environment around them, their reactivity to competitive situations (e.g., hostile persons' tendency to view others and daily situations to be more threatening than they are really are and the likelihood of displaying heightened physiological reactivity), and the findings that exercise under competitive conditions produces negative affect, an exercise environment that has the slightest competitive ambiance may engender negative cognition and affect and heightened physiological reactivity among these individuals.

**Competitive and Performance Evaluation: Positive Feedback and Negative Feedback**

The perception of competition and evaluation can be influenced by giving feedback on one's exercise performance compared to that of others. Evaluative
performance feedback may serve as a major factor in influencing how one exercises
and how one reacts to exercise physiologically and affectively. For example, those who
perceive they are not performing well may feel hostile during and after exercising and not
benefit from the positive effect of exercising. They may react with heightened
physiological reactivity and change the way they exercise by working more intensely or
giving up from the perception of defeat.

The type of feedback one receives affects one’s affect, physiological responses,
and behavior. Studies involving hostile persons and competitive and challenging
situations have generally found the presence of negative affect and heightened
physiological reactivity (e.g., Hardy & Smith, 1988; Smith et al., 1988). Thus, negative
feedback may also lead to similar effects on affect and physiology. However, this was
only partially supported by studies done on hostility and feedback. For example,
although Prkachin et al. (1991) did find that hostile persons’ diastolic blood pressure
became higher when given negative performance feedback than positive or no feedback,
and this pattern was not found in the low-hostile persons, there were no differences in
hostile affect between the different feedback conditions. Similarly, Hardy and Smith
(1988) also found that despite an increase in psychophysiological reactivity in the high-
conflict group, the affect in both hostile persons in the high-conflict condition and those
in the low-conflict condition was equally negative.

In terms of the effect of negative feedback on one’s behavior, it tends to serve as a
deterrent to the behavior for some individuals and a reinforcer for others. Baron (1988)
found that those who received destructive criticism (feedback that was nonspecific, harsh
in tone, and attributed poor performance to internal causes), versus constructive criticism, reported anger and tension and that they would be likely to handle future disagreements with the source of the negative feedback with avoidance, resistance, or competition. The author also found that although the participants’ self-efficacy and self-set goals were affected, their actual task performance was not always affected. He suggested that this might be due to the familiarity of the task, in that familiar tasks were more affected by destructive criticism than unfamiliar ones. It may also be due to individual differences in that when faced with negative feedback, some people increase their effort and self-set goals, whereas others decrease them (Bandura & Cervone, 1986). Such individual differences are found in perceived self-efficacy, self-evaluation, and self-set goals. For example, those who see little in their capability will likely be discouraged by failure, whereas those who believe that they are competent will likely intensify their effort when dissatisfied with their performance. Resiliency of perceived self-efficacy has also been suggested to be a possible factor in explaining individual differences in continuing effort when faced with obstacles (Bandura, 1986).

Positive verbal feedback may lead to positive affect, increasing adherence to exercise in the long run. It has been shown that positive feedback increases adherence among cardiac rehabilitation patients (Ewart, Taylor, Reese, & DeBusk, 1983). It is not clear, however, whether hostile individuals require positive feedback in persisting with a task in the short run. A study on the effects of encouragement on Type A persons in helping them persist during maximal exercise on a treadmill found that those people did
not seem to need encouragement and were able to give their best efforts, despite the physical bearing of the exercise (Chitwood, Moffatt, Burke, Luchino, & Jordan, 1997).

An important construct related to exercise behavior, affect, and perhaps physiologically reactivity, is self-efficacy. Self-efficacy may be influenced by performance evaluation, and thus, manipulated by the type of feedback given. Self-efficacy has been shown to be related to affective states during and after exercise (McAuley & Courneya, 1992; McAuley, Talbot, & Martinez, 1999). Specifically, more efficacious individuals reported significantly more positive well-being and less psychological distress during and following exercise, and those who experienced less psychological distress during activity were more efficacious after exercise. Self-efficacy affects cardiac patients undergoing rehabilitation in that those who are more self-efficacious are more likely to comply with exercise prescription than those who are less self-efficacious (Lemanski, 1990). Bandura (1977, 1986) found that individuals with a higher sense of self-efficacy approach more challenging tasks, put forth more effort, and persist longer when faced with obstacles and aversive stimuli. Negative feedback regarding one’s performance may serve as a source of psychological distress during exercise and a way of undermining self-efficacy, increasing negative affect, and physiological reactivity, and influencing the way one exercises; whereas positive feedback may have the opposite effect of increasing self-efficacy and reducing distress. Although self-efficacy is not examined in the proposed study, its effect on behavior, affect, and perhaps even physiology warrants its inclusion in future research on exercise and feedback.
In sum, little is known about the relationship between hostility and exercise. Given that hostility may be the main component of the Type A behavior pattern associated with cardiovascular diseases, hostility may be present among many of the participants in cardiac rehabilitation programs. Hence, research on exercise and cardiovascular diseases needs to focus on hostile individuals. No studies have been conducted on the relationship among exercise behavior, affect, and cardiovascular reactivity in a competitive exercise setting with hostile individuals. Specifically, the effect of competition and evaluation produced by positive and negative feedback on a hostile person's cardiovascular reactivity, affect, and exercise behavior is unknown. Thus, this study will investigate hostile persons' cardiovascular reactivity, affective state, and the way they exercise in a competitive, evaluation condition produced by performance feedback.
CHAPTER III

METHODOLOGY

Participants

Eighty-two undergraduate students at Utah State University were the participants in this study. They were a convenient sample selected from more than 400 students in undergraduate introductory psychology classes based on their scores on the Ho. The participants received extra credit for their participation. Only those who obtained a hostility score 1/2 standard deviation above the mean were included in the study. The mean score of these students was 19, and the standard deviation was 7. Thus, the score for inclusion was 22. The mean Ho score of the 82 participants was 26.71 ± 4.60. There were 34 men and 48 women, and they were similarly distributed among the three conditions. The mean age of the participants was 21 ± 2.15. Table 1 presents these

Table 1

*Participant Characteristics*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>M</th>
<th>SD</th>
<th>N (Male)</th>
<th>N (Female)</th>
<th>Total N in each group</th>
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<td>Age</td>
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<td>12</td>
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<td>12</td>
<td>16</td>
<td>28</td>
</tr>
<tr>
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<td>16</td>
<td>10</td>
<td>16</td>
<td>26</td>
</tr>
<tr>
<td>No feedback</td>
<td>12</td>
<td>16</td>
<td>12</td>
<td>16</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>48</td>
<td>34</td>
<td>48</td>
<td>82</td>
</tr>
</tbody>
</table>
data.

Study Design

The study examined the effect of feedback on three distinct categories of variables: affect, physiological reactivity, and behavior. The independent variable, feedback, was a between subjects variable with three different levels: positive, negative, and no feedback. The dependent variables measured affect (consisting of two different measures and variables: Exercise-Induced Feeling Inventory [EFI] and Ratings of Perceived Exertion [PRE]), physiological reactivity (blood pressure and heart rate), and exercise behavior (distance biked). The variables under the categories of affect and behavior were measured at pretest and posttest. Each variable was analyzed separately in a 3 x 2 mixed model analysis of variance (ANOVA) with feedback as the between subjects variable and time (pre, post) as the within-subjects variable. The variables under physiological reactivity had three levels: resting, pretest, and posttest. They were also analyzed separately in 3 x 3 mixed model ANOVA.

Procedures

Students were screened for hostility using the Ho (see Appendix C). Only those who scored high (i.e., 1/2 standard deviation above the mean) on hostility were contacted for further participation. Each person who participated was randomly assigned to one of the three conditions: positive feedback, negative feedback, and no feedback regarding
their performance on a bicycle ergometer. Appendix B is a copy of the experimental protocol used by the experimenters.

Participants were contacted by phone and scheduled for the lab session. They were instructed to get a good night’s sleep, not to exercise, and not to eat a heavy meal prior to participation in the study. They were also asked to dress comfortably for exercise. Each participant was briefly informed of the procedures involved—that they would be walking on a treadmill for 8 min, riding a stationary bicycle for 10 min, and asked to fill out some questionnaires. All participants completed an institutional review board approved informed consent form prior to participation (see Appendix A).

Because it would be difficult to recruit participants with similar fitness level, fitness level was measured. A brief fitness test of walking on a treadmill (single-stage submaximal treadmill walking test; Ebbeling, Ward, Puleo, Widrick, & Rippe, 1991) was conducted prior to the actual experiment of riding on a stationary bicycle in order to estimate each participant’s fitness level, as measured by their VO$_2$max. Various questions were asked of the participants to determine the speed of the treadmill setting at which they were to walk. The questions were the following: “How much do you exercise on a weekly basis? What type(s) of exercise? How many times a week? How many hours each week? One average, what is your RPE on those activities (see Appendix E)? When was the last time you exercised? How many hours of sleep did you get last night? How fit do you think you are compared to other men/women your age?” Those who were assessed to be unfit or average (e.g., does not exercise much), based on the questions asked, walked at a speed of 3 mph. Those who were determined to be
somewhat fit (e.g., exercise 2-3 hours/week) walked at a speed of 3.5 mph. Those who were assessed to be very fit (e.g., swim, hike, jog for several hours several times a week; run the marathon) walked at a speed of 4 mph. The fitness test was 8 min long and consisted of two parts: a 4-min warmup and a 4-min test. Participants first warmed up at the determined speed for 4 min at a 0% grade. The participants’ heart rate was assessed at the end of each minute using a Polar heart rate monitor that participants wore around their abdomen. Their RPE was assessed at the end of the 4 min. Adjustment of speed was made based on the participants’ heart rate at the end of the first 2 min. If the heart rate during this time fell outside of the range of 50-70% of age predicted maximum, then the speed was increased by 0.2-0.5 mph. The range of 50-70% of age predicted maximum was calculated from the following formulas:

Target heart rate of 50-70% of age predicted maximum = (220-age) x .50,  
(220-age) x .70

After the 0% grade warm-up, the grade was raised to 5%, while the participant continued to walk. The speed remained the same. Heart rate was, again, measured at the end of each minute and RPE at the end of the test. Each participant’s VO$_2$max was calculated from the following formula (Ebbeling et al., 1991):

Estimated VO$_2$max = 15.1 + (21.8 x speed) – (0.327 x HR) – (0.263 x speed x age) + (0.00504 x HR x age) + (5.98 x gender).  
Gender = 0 for females, 1 for males.

This fitness test was a quick and simple way to predict each participant’s fitness level and would not tire the participant out for the actual part of the experiment.
A factor that may influence individuals' performance are temperature and humidity (Gleeson, 1998). Thus, the temperature and humidity of the exercise lab were measured at the beginning of each session.

Each person participated individually and exercised in the following procedures. When each participant came to the lab, his/her resting heart rate and blood pressure were first taken. S/he was then asked to complete the EFI, which assessed his/her mood prior to exercising (see Appendix D). Each person’s fitness level was assessed using the 8 min submaximal treadmill walking test (Ebbeling et al., 1991). After the fitness test, the participant rested for 10 min, after which a second measure of resting blood pressure and heart rate was taken and the RPE assessed. Resting heart rate and blood pressure were measured twice and will be combined (averaged) during data analysis. The purpose of taking two measures was to obtain more reliable data. Resting heart rate and blood pressure at the onset of the study could be influenced by variables beyond the experimenter's control. The second measure was likely to be a more accurate measure of participants’ resting heart rate and blood pressure due to the fact that everyone experienced the same thing (the fitness test) before the measure was taken. After the break s/he was allowed a minute to warm up and become familiar with the bicycle ergometer. S/he then biked on the ergometer for 10 min. The specific instruction given was as follow: “I would like you to bike for 10 min. Please work hard because you’re competing with other college students.” Half way through the biking session blood pressure, heart rate, RPE, and distance biked were measured and feedback regarding their performance was given. Depending on the condition the participant was in, s/he was
given positive, negative, or no feedback. In the positive feedback condition, s/he was
told the following: “I’m looking at this chart of biking times, and you’re doing better than
80% of college students at the rate you are going. Keep up the good work.” The
negative feedback was given as follows: “I’m looking at this chart of biking times, and
you’re doing worse than 80% of college students at the rate you are going. You really
need to work harder.” Those in the no feedback condition did not receive any feedback.
The feedback given was not related to how they were actually performing, but was
determined solely on group membership. The wording of the feedback was
predetermined to ensure consistency. Finally, at the end of the 10 min, distance biked
was measured and RPE and physiology (blood pressure and heart rate) assessed, along
with the administration of the EFI. In addition, a short questionnaire was administered
that assessed how believable the feedback was (see Appendix F). Finally, the participant
was debriefed (see Appendix G). If participants asked questions regarding their
performance, how their performance was assessed, or any other questions during the
experiment, they were told that all questions would be answered after the exercise
session.

Instrumentation

The following self-report measures were used in the study: Cook-Medley
Hostility Inventory (Ho; Cook & Medley, 1954), Exercise-Induced Feeling Inventory
(EFI; Gauvin & Rejeski, 1993), Borg’s Ratings of Perceived Exertion Scale (RPE; Borg,
1985), and a short questionnaire assessing the believability of the feedback received. The
exercise equipments used were Quinton Q55 and Pro-form 585 Pi treadmills and a Monark 824 E bicycle ergometer. Blood pressure was measured using a blood pressure/pulse monitor SD-700A. Heart rate was measured using a Polar heart rate monitor and the blood pressure/pulse monitor.

Although various researchers have proposed different types or dimensions of hostility, it is not the purpose of this study to distinguish between the different types. Because the relation between hostility and cardiovascular diseases has been established by many previous studies using the Cook-Medley Hostility Inventory (e.g., Barefoot et al., 1983; Shekelle et al., 1983; Williams et al., 1980; Woodall & Matthews, 1993) and also because Ho scores have been found to have stronger predictive power of hostility for younger men than older men (Siegman, Dembroski, & Ringel, 1987), the Ho was chosen for the screening of hostility in this study. The type of hostility of interest, then, is the cynical, attitudinal type and not the overt type of hostility. The Cook-Medley Hostility Inventory (Ho; Cook & Medley, 1954) is a 50-item true-false scale derived from the Minnesota Multiphasic Personality Inventory (MMPI). Some items are “When someone does me a wrong I feel I should pay him back if I can, just for the principle of the thing,” and “No one cares much about what happens to you.” High scores on the Ho have been found to correlate with cardiovascular disease and the stability of the scores has been shown to be quite high (e.g., Barefoot et al.; Shekelle et al.). The Ho has high levels of internal consistency with Cronbach’s alphas averaging about .80 and a high test-retest reliability, \( rs = .84 \) (Smith & Frohm, 1985). Evidence of convergent and discriminant validity is provided by the finding that the Ho scale is significantly more highly
correlated with trait anger than with trait anxiety or depression (Smith & Frohm), and that the Ho is also significantly correlated with the Buss-Durkee Hostility Inventory resentment and suspicion subscales and with measures of mistrust and cynicism (e.g., Hardy & Smith, 1988; Smith et al., 1988).

The EFI (Gauvin & Rejeski, 1993) consists of 12 Likert-scale items that measure four feeling states related to exercise: revitalization, tranquility, positive engagement, and physical exhaustion. The scale ranges from 0 (do not feel) to 4 (feel very strongly). It has good internal consistency (reliabilities are greater than .80), concurrent and discriminative validity with existing measures of mood and affect, and construct validity. It is sensitive to changes in exercise-induced feelings states (Gauvin & Rejeski) and has been used in many studies involving exercise-induced feeling states (e.g., Annesi & Mazas, 1997; Gauvin et al., 1996; Rejeski, Gauvin, Hobson, & Norris, 1995). The measure was used as a pretest (before the exercise session) and a posttest (at the end of the exercise session after feedback had been given).

Participants’ perceived exertion was determined by using the Borg scale. It was used to assess the participants’ subjective ratings of how hard they were exercising. The ratings range from 6 (no exertion at all) and 20 (maximal exertion). Test-retest reliabilities of .80 and higher have been reported for the Borg, and its validity in the assessment of perceived physical work intensity has been demonstrated by many studies (Borg, 1985). It has been used widely in both research and clinical work, involving exercise (e.g., Dunbar, Goris, Michielli, & Kalinski, 1994), occupational physical work (Borg, 1985), and psychological stress (e.g., Borg, 1970; Myers, 1994; Noble, 1982), to
name a few. The Borg scale was used for two reasons. One was to provide an additional measure of how hard the participants were biking. Another was to assess whether the participants were aware of their physiological state.

Participants in the negative and positive feedback groups completed a brief questionnaire at the end of the study. It assessed how believable they thought the feedback was, and consisted of one 5-point Likert-scale item that asked the participants to circle the number that corresponded to how believable the feedback was. The numbers ranged from 1-5, with 1 being “not at all believable,” 3 being “somewhat believable,” and 5 being “completely believable.” The second part of the questionnaire consisted of an open-ended question that asked the participants whether they thought the feedback was believable and to provide a rationale for their answer.

Quinton Q55 and Pro-form 585 Pi treadmills were used for the fitness test. One of the treadmills was used only in several fitness sessions and speed was calibrated for the two treadmills. Hence, using two different treadmills did not affect the participants’ performance on this test.

A bicycle ergometer with two kg of weights as resistance was used for the cycling task. A stationary bike, instead of a treadmill, was the exercise instrument of choice because riding a stationary bike indoors is a relatively unfamiliar task and most participants would not be familiar enough with it to know how well they were performing. A stationary bike is also ideal in a competitive situation because the participant has good control of the speed and distance of riding. Another exercise instrument, such as a treadmill, would not be as good because of the potential danger of
falling of the treadmill when running fast on it, and the participant cannot adjust the speed of the treadmill. A Monark 824 E bicycle ergometer was used.

A Polar heart rate monitor was used to measure heart rate. A blood pressure/pulse monitor SD-700A was used to measure blood pressure and heart rate. The heart rate obtained from this machine was combined with the heart rate measured with the polar heart rate monitor for each reading to obtain an average.

Statistical Analyses

The data collected from the experiments were analyzed using the Statistical Packages for Social Sciences (SPSS), 10.1 for windows. One-way between groups ANOVA was used to examine differences among the three feedback groups in fitness level. It was also used to assess differences in temperature and humidity among the three groups. Independent sample $t$ tests were used to determine differences between the negative and positive feedback groups in the believability of the feedback given. Mixed model ANOVAs were the primary test in data analysis. They were used in examining the dependent variables of EFI, RPE, distance, heart rate, and blood pressure. In the case of RPE for which an interaction effect between group and time was found, a paired-samples $t$ test was also calculated to determine for which group(s) the prefeedback and postfeedback differences existed. A one-way between-subjects ANOVA was also run to compare the groups at pretest and at posttest for RPE.
CHAPTER IV
RESULTS

Preliminary Analyses

The first step in data analysis was to determine if there were differences in fitness levels among the three groups, as measured by participants’ VO$_{2\text{max}}$, using a one-way between groups ANOVA. The means and standard deviations for the negative feedback, positive feedback, and no feedback groups were $M = 44.43$, $SD = 11.83$; $M = 46.03$, $SD = 9.05$; $M = 43.35$, $SD = 7.76$, respectively (see Table 2). These means indicate that the participants’ fitness level ranged from average to slightly above average (Golding, Myers, & Sinning, 1989). There were no significant differences among the three groups on fitness level, $F (2, 79) = .45$, $p = .64$, indicating that there were no group differences.

Environmental factors, such as temperature and humidity in the exercise lab, were measured. The means and standard deviations for temperature in Fahrenheit were 70.50, 2.20; 69.72, 2.94; and 70.75, 2.91, for the negative feedback, positive

Table 2

<table>
<thead>
<tr>
<th>Feedback condition</th>
<th>VO$_{2\text{max}} (M)$</th>
<th>VO$_{2\text{max}} (SD)$</th>
<th>df</th>
<th>$F$</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative feedback</td>
<td>44.43</td>
<td>11.83</td>
<td>2</td>
<td>.45</td>
<td>.64</td>
</tr>
<tr>
<td>Positive feedback</td>
<td>46.03</td>
<td>9.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No feedback</td>
<td>43.35</td>
<td>7.76</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
feedback, and no feedback groups, respectively. Humidity data were missing for three sessions. The means and standard deviations for humidity were 44.38, 6.35; 43.43, 6.68; and 43.22, 6.52, for the negative feedback, positive feedback, and no feedback groups, respectively. One-way ANOVA found that both the temperature and humidity in the lab were similar for all three groups, $F(2, 79) = 1.03, p = .36$, $F(2, 73) = .24, p = .79$, respectively. Thus, temperature and humidity could not account for any differences found among the three groups.

An independent sample $t$-test was calculated on the feedback believability scale. The mean and standard deviation scores for the believability of the feedback for the negative feedback condition are 3.11 and 1.31. The mean and standard deviation for the positive feedback condition are 2.92 and .98 (see Table 3). The feedback (positive and negative) given to the participants was deemed to be equally believable between the two groups, $t(52) = .58, p = .56$. The feedback scale ranges from "not at all believable" to "completely believable," and a three on the feedback believability scale indicates that the feedback is "somewhat believable." Thus, given that the means ranged from 2.92 to

<table>
<thead>
<tr>
<th>Feedback condition</th>
<th>$N$</th>
<th>$M$</th>
<th>$SD$</th>
<th>$t$</th>
<th>$df$</th>
<th>Sig.</th>
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<td>28</td>
<td>3.11</td>
<td>1.31</td>
<td>.58</td>
<td>52</td>
<td>.56</td>
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<tr>
<td>Positive feedback</td>
<td>26</td>
<td>2.92</td>
<td>.98</td>
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</table>
3.11, it appears that the feedback manipulation was not particularly potent, which means that the feedback might not have been very effective in creating any differences between the groups.

**Principal Analyses**

Three (positive, negative, no feedback) x 2 (prefeedback, postfeedback) mixed model ANOVA’s with EFI, RPE, and distance as the dependent variables were calculated. Additionally, 3 (positive, negative, no feedback) x 3 (resting, prefeedback, postfeedback) mixed model ANOVA’s with heart rate and blood pressure as the dependent variables were calculated.

**Exercise Induced Feeling Inventory**

The EFI was scored and analyzed according to the four subscales derived from Gauvin and Rejeski’s (1993) factor analysis. The four subscales measure four distinct feeling states: positive engagement, revitalization, tranquility, and physical exhaustion. See Table 4 for means and standard deviations.

No time main effect was found for positive engagement, $F(1, 79) = 1.09, p = .30$. There was also neither a group main effect, $F(2, 79) = 2.74, p = .07$, nor an interaction effect, $F(2, 79) = 1.40, p = .25$. That is, there were no differences between groups in either the pretest or posttest, and positive engagement did not differ between pretest and posttest for any of the three groups.

A group main effect was found for revitalization, $F(2, 79) = 5.46, p = .006$. A Tukey test showed that the positive feedback and negative feedback groups were
significantly different in that the positive feedback ($M=6.96$) felt more revitalized than the negative feedback group ($M=5.16$). However, there was neither a time main effect, $F(1, 79) = 3.58, p = .06$, nor an interaction effect, $F(2, 79) = .82, p = .44$, which meant that the difference in feelings of revitalization between the positive and negative feedback groups was present at pretest and did not change as a result of the experiment.

A main effect for time was found for tranquility, $F(1, 79) = 34.42, p < .000$. The groups felt more tranquil before, $M = 8.40, SD = 2.50$ than after participation in the experiment, $M = 6.21, SD = 2.98$. However, there was neither a group main effect, $F(2, 79) = 2.81, p = .07$, nor an interaction effect, $F(2, 79) = 1.08, p = .35$, which meant that although there was a decrease in the feeling of tranquility, this decrease was seen in all three groups.

Finally, a main effect of time on physical exhaustion was also found, $F(1, 79) = 41.16, p < .000$, in that the groups felt more physically exhausted at posttest, $M = 4.04, SD = 2.83$, than at pretest, $M = 6.84, SD = 2.80$. This, again, was expected due to the exercise. However, there was neither a group main effect, $F(2, 79) = 1.05, p = .36$, nor an interaction effect, $F(2, 79) = .02, p = .98$, which indicates that although there was an increase in feelings of physical exhaustion from pretest to posttest, this increase was observed in all of the groups.

**Rating of Perceived Exertion**

A main effect for time was found on RPE, $F(1, 79) = 103.71, p < .000$. Participants’ RPE’s were higher postfeedback, $M =17.09, SD = 1.70$, than prefeedback, $M = 15.66, SD = 1.84$. This was expected because the longer they exercised, the more
Table 4

**Exercise-Induced Feeling Inventory**

<table>
<thead>
<tr>
<th>Feedback condition</th>
<th>Positive engagement</th>
<th>Revitalization</th>
<th>Tranquility</th>
<th>Physical exhaustion</th>
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<tr>
<td></td>
<td>Prefeedback</td>
<td>Postfeedback</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Negative feedback</td>
<td>6.82</td>
<td>2.80</td>
<td>6.39</td>
<td>2.59</td>
</tr>
<tr>
<td>Positive feedback</td>
<td>7.58</td>
<td>2.56</td>
<td>8.23</td>
<td>2.97</td>
</tr>
<tr>
<td>No feedback</td>
<td>7.07</td>
<td>2.36</td>
<td>7.89</td>
<td>2.13</td>
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</table>

**ANOVA table**

<table>
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<th></th>
<th>df</th>
<th>F</th>
<th>Sig.</th>
<th>df</th>
<th>F</th>
<th>Sig.</th>
<th>df</th>
<th>F</th>
<th>Sig.</th>
<th>df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
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<td>.071</td>
<td>2</td>
<td>5.46</td>
<td>.006**</td>
<td>2</td>
<td>2.81</td>
<td>.066</td>
<td>2</td>
<td>1.05</td>
<td>.355</td>
</tr>
<tr>
<td>Time (pretest, posttest)</td>
<td>1</td>
<td>1.09</td>
<td>.300</td>
<td>1</td>
<td>3.58</td>
<td>.062</td>
<td>1</td>
<td>34.42</td>
<td>.000**</td>
<td>1</td>
<td>41.16</td>
<td>.000**</td>
</tr>
<tr>
<td>Group x time</td>
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<td>1.96</td>
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<td>2</td>
<td>.823</td>
<td>.443</td>
<td>2</td>
<td>1.08</td>
<td>.345</td>
<td>2</td>
<td>.018</td>
<td>.982</td>
</tr>
</tbody>
</table>

**p < .01**
exertion they should perceive due to fatigue. This increase in RPE is truly significant considering that the period between the first and second RPE ratings was merely 5 min. An effect size was also calculated. The effect size of .81 is considered to be large (Cohen, 1977), which indicates that pre and postfeedback RPE were significantly different. There was no group main effect, $F(2, 79) = 1.89, p = .16$, indicating that the groups did not differ at either prefeedback or postfeedback. An interaction was found between group and time, $F(2, 79) = 4.23, p = .018$ (see Figure 1). A paired-samples $t$ test was then conducted to determine for which group(s) the prefeedback and postfeedback differences existed. The paired-samples $t$-test showed that the prefeedback and postfeedback differences existed in all three groups: $t(27) = .72, p < .000; t(25) = .73, p < .000; t(28) = .78, p < .000$, for the negative feedback, positive feedback, and no feedback conditions, respectively. An one-way between-subjects ANOVA was

![Figure 1: Interaction effects of group and time for rating of perceived exertion.](image-url)
also run to compare the groups at pretest and at posttest. Again, no significant differences were found between the groups in either pretest, $F(2, 79) = 2.60, p = .08$, or posttest, $F(2, 79) = 1.74, p = .18$. Thus, prefeedback and postfeedback RPE were

**Distance**

Distance data was missing for one participant. A main effect of time for distance was found, $F(1, 78) = 4.31, p = .04$. Participants biked further before they received feedback, $M = 2.40$ km, $SD = .61$ km; than after they received the feedback, $M = 2.31$ km, $SD = .70$ km. No significant group effect was found, $F(2, 78) = .08$.

Table 5

*Ratings of Perceived Exertion*

<table>
<thead>
<tr>
<th>Feedback condition</th>
<th>Prefeedback</th>
<th>Postfeedback</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Negative feedback</td>
<td>15.39</td>
<td>1.89</td>
</tr>
<tr>
<td>Positive feedback</td>
<td>15.27</td>
<td>1.80</td>
</tr>
<tr>
<td>No feedback</td>
<td>16.29</td>
<td>1.72</td>
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</table>

ANOVA table

<table>
<thead>
<tr>
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<th>df</th>
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<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>1.89</td>
<td>.157</td>
</tr>
<tr>
<td>Time (prefeedback, postfeedback)</td>
<td>1</td>
<td>103.71</td>
<td>.000**</td>
</tr>
<tr>
<td>Group x time</td>
<td>2</td>
<td>4.23</td>
<td>.018*</td>
</tr>
</tbody>
</table>

* $p < .05$, ** $p < .01$
There was also no interaction effects, $F(2, 78) = 2.21, p = .12$. Although the different for all groups and no group differences were found at either prefeedback or postfeedback. See Table 5 for means and standard deviations. Participants biked further prefeedback than postfeedback, this was seen in all three groups. See Table 6.

*Heart Rate*

Heart rate was measured using the polar heart rate monitor and a blood pressure/heart rate monitor. The two heart rates were combined (average) for the analysis. Heart rate was measured four times: before the experiment, after the fitness test, before feedback was given during the bike session, and at the end of the bike.

Table 6

*Distance (in Kilometers)*

<table>
<thead>
<tr>
<th>Feedback condition</th>
<th>Prefeedback</th>
<th>Postfeedback</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Negative feedback</td>
<td>2.32</td>
<td>.55</td>
</tr>
<tr>
<td>Positive feedback</td>
<td>2.39</td>
<td>.63</td>
</tr>
<tr>
<td>No feedback</td>
<td>2.49</td>
<td>.65</td>
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</table>

ANOVA table

<table>
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<tr>
<td>Group</td>
<td>2</td>
<td>.08</td>
<td>.919</td>
</tr>
<tr>
<td>Time (prefeedback, postfeedback)</td>
<td>1</td>
<td>4.31</td>
<td>.041*</td>
</tr>
<tr>
<td>Group x time</td>
<td>2</td>
<td>2.21</td>
<td>.116</td>
</tr>
</tbody>
</table>

*<p < .05*
session after feedback was given. Some heart rate data were missing. The first
two heart rates were combined to form one resting heart rate. There was a main effect for
time, $F(2, 150) = 569.70, p < .000$, but not for group, $F(2, 75) = 2.00, p = .14$. There
was no interaction effect, $F(4, 150) = 1.87, p = .12$. There was a significant increase
from resting heart rate to heart rate measured during and after the exercise. A one-way
within-subjects ANOVA on heart rate was calculated, which showed that resting,
prefeedback, and postfeedback heart rates were all significantly different from one
another, $F(2, 237) = 278.25, p < .000$. The resting heart rate mean was 73.66, $SD = 11.35$. The mean for prefeedback heart rate was 125.07, $SD = 21.17$. The mean for postfeedback heart rate was 133.55, $SD = 18.53$. See Table 7.

Table 7

*Heart Rate*

<table>
<thead>
<tr>
<th>Feedback condition</th>
<th>Resting M</th>
<th>Resting SD</th>
<th>Prefeedback M</th>
<th>Prefeedback SD</th>
<th>Postfeedback M</th>
<th>Postfeedback SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative feedback</td>
<td>73.34</td>
<td>13.19</td>
<td>125.48</td>
<td>21.80</td>
<td>132.52</td>
<td>16.68</td>
</tr>
<tr>
<td>Positive feedback</td>
<td>73.10</td>
<td>11.71</td>
<td>118.50</td>
<td>18.78</td>
<td>128.96</td>
<td>22.12</td>
</tr>
<tr>
<td>No feedback</td>
<td>74.49</td>
<td>9.17</td>
<td>131.20</td>
<td>21.39</td>
<td>138.65</td>
<td>16.06</td>
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</table>

ANOVA table

<table>
<thead>
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<th>Sig.</th>
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<tbody>
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<td>2.00</td>
<td>.143</td>
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<tr>
<td>Time (prefeedback, postfeedback)</td>
<td>2</td>
<td>569.70</td>
<td>.000**</td>
</tr>
<tr>
<td>Group x time</td>
<td>4</td>
<td>1.87</td>
<td>.118</td>
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</tbody>
</table>

**$p < .01$**
**Blood Pressure**

Systolic and diastolic blood pressure were also measured four times at the same times immediately before heart rate was taken. Similar to heart rate, the first two readings of blood pressure were combined to form one resting blood pressure. A main effect of time for systolic blood pressure was found, $F(2, 156) = 135.89, p < .000$. However, neither a group main effect, $F(2, 78) = .29, p = .75$, nor an interaction effect was found, $F(4, 156) = 1.01, p = .41$. The change in systolic blood pressure from resting to exercise was expected due to exercise. However, it was not clear whether there was a difference in prefeedback and postfeedback systolic blood pressure. Thus, a one-way ANOVA was calculated on the groups to determine this. It was found that resting

Table 8

**Systolic Blood Pressure**

<table>
<thead>
<tr>
<th>Feedback condition</th>
<th>Resting $M$</th>
<th>Resting $SD$</th>
<th>Prefeedback $M$</th>
<th>Prefeedback $SD$</th>
<th>Postfeedback $M$</th>
<th>Postfeedback $SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative feedback</td>
<td>109.43</td>
<td>16.25</td>
<td>147.43</td>
<td>25.78</td>
<td>147.71</td>
<td>33.27</td>
</tr>
<tr>
<td>Positive feedback</td>
<td>107.06</td>
<td>13.25</td>
<td>146.48</td>
<td>27.19</td>
<td>151.80</td>
<td>23.77</td>
</tr>
<tr>
<td>No feedback</td>
<td>107.46</td>
<td>14.10</td>
<td>156.68</td>
<td>31.47</td>
<td>151.43</td>
<td>29.07</td>
</tr>
</tbody>
</table>

ANOVA table

<table>
<thead>
<tr>
<th></th>
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<th>$F$</th>
<th>$Sig.$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>2</td>
<td>.29</td>
<td>.75</td>
</tr>
<tr>
<td>Time (prefeedback, postfeedback)</td>
<td>2</td>
<td>135.89</td>
<td>.000**</td>
</tr>
<tr>
<td>Group x time</td>
<td>4</td>
<td>1.01</td>
<td>.41</td>
</tr>
</tbody>
</table>

**$p < .01$**
systolic blood pressure \((M = 108.01, SD = 31.76)\) was significantly different from systolic blood pressure measured prior to \((M = 150.33, SD = 28.32)\) and after \((M = 150.26, SD = 28.84)\) the feedback, \(F(2, 241) = 79.45, p < .000\), which were not significantly different from each other. No significant group, \(F(2, 77) = 1.10, p = .34\), or time, \(F(2, 154) = .98, p = .38\), differences were found for diastolic blood pressure. Clearly, there is no interaction effect, \(F(4, 154) = 1.50, p = .20\). Thus, diastolic blood pressure taken during the resting periods, before feedback, and after feedback were not significantly different for any of the groups. See Table 8 and 9 for means and standard deviations.

Table 9

*Diastolic Blood Pressure*

<table>
<thead>
<tr>
<th>Feedback condition</th>
<th>Resting</th>
<th></th>
<th>Prefeedback</th>
<th></th>
<th>Postfeedback</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(M)</td>
<td>(SD)</td>
<td>(M)</td>
<td>(SD)</td>
<td>(M)</td>
</tr>
<tr>
<td>Negative feedback</td>
<td>68.87</td>
<td>12.01</td>
<td>62.41</td>
<td>22.00</td>
<td>63.22</td>
</tr>
<tr>
<td>Positive feedback</td>
<td>66.64</td>
<td>8.89</td>
<td>55.28</td>
<td>19.06</td>
<td>60.88</td>
</tr>
<tr>
<td>No feedback</td>
<td>63.91</td>
<td>11.01</td>
<td>63.91</td>
<td>36.03</td>
<td>62.07</td>
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</tbody>
</table>

ANOVA table

<table>
<thead>
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<th></th>
<th>(df)</th>
<th>(F)</th>
<th>(Sig.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
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<td>.34</td>
</tr>
<tr>
<td>Time (prefeedback, postfeedback)</td>
<td>2</td>
<td>.98</td>
<td>.38</td>
</tr>
<tr>
<td>Group x time</td>
<td>4</td>
<td>1.50</td>
<td>.20</td>
</tr>
</tbody>
</table>
Chapter V
Discussion

Research Questions

The results of the treadmill fitness test ensured that the three groups were similar in fitness level. Thus, any differences in the experiment could not be attributed to differences in fitness level. Similarly, environmental factors, specifically temperature and humidity, did not differ between exercise sessions, and should not have contributed to any differences in the participants’ performance. Finally, the feedback given was equally believable between the positive and negative feedback groups, however, it was not deemed to be very believable by either. This could have affected the results of the study and is an important finding to be discussed below.

The lack of significant findings on the EFI subscales is difficult to interpret. Exercise per se should have had a positive effect on the participants’ feeling states, but negative feedback should have decreased or eliminated whatever positive moods generated from the exercise and created negative moods instead, whereas positive feedback should have made the positive feelings even more positive. Therefore, changes in feeling states should have been different among the different groups. This was not seen. Although main effects were seen, there were no interaction effects, which indicates that the changes in the EFI feelings states were due to exercise alone and not to the effect of being in a certain feedback group. Again, an explanation for the result may be the lack of treatment validity and/or insufficient power. In addition, it must be kept in mind that
the participants were exercising under a competitive condition, which could have influenced their feeling states.

The main effect on physical exhaustion was not surprising, given the observation that the participants biked hard and many expressed how worn-out they felt. However, another study has found feelings of physical exhaustion to be similar prior to and postexercise. Of course, this could be due to the type of exercise that one engages in (Gauvin et al., 1996). Parfitt, Markland, and Holmes (1994) found moderate exercise (60% VO$_2$max) to produce more positive affect than submaximal (90% VO$_2$max) exercise. Another study on runners found an increase in negative affect or a change to a more neutral affect after one hour of running on a treadmill at a moderate intensity (approximately 70% VO$_2$max; Acevedo, Gill, Goldfarb, & Boyer, 1996). Although the 10-min bike session with two kilograms of weights as resistance was intended to be a moderate physical task, it appeared to have been very strenuous for most of the participants.

The presence of a group main effect and the lack of an interaction and a time main effect on revitalization showed that the positive feedback group was feeling significantly more revitalized at the onset of the experiment, compared to participants in the negative feedback and no feedback groups, and this difference was seen in the posttest as well. It is unknown whether the positive group's maintenance of the feelings of revitalization is due to the exercise, the feedback, or both. This finding suggests that even with random assignment, the groups were unequal on revitalization to begin with. This individual difference in affect at pretest raises the question of how the other variables of interest in
this study—exercise behavior, physiological reactivity, and so forth—were affected. Gauvin et al. (1996) found an increase in revitalization due to exercise. Again, the type of exercise may be a factor, as are the exercise setting and minimal competition.

The groups felt more tranquil prior to than after exercise. This does not support past research, which found tranquility rating to be higher postexercise than preexercise (Gauvin et al., 1996). However, this may be due to the exercise setting, which is a laboratory in this study with competition as a characteristic, whereas the participants in the Gauvin and colleagues’ study exercised in a natural setting, in which competition was minimal.

It was hypothesized that exercise alone would lead to an increase in positive feeling states in the no feedback group. This was not supported. Instead, there was neither a significant change in feelings of positive engagement nor revitalization between preexercise and postexercise, and feelings of tranquility actually decreased. The lack of support for this hypothesis is thought to be due to the added factor of exercising in a competitive situation. Another possible explanation for the low feelings of positive affect at posttest may be the timing of the posttest. Some studies have found that measuring affect 5 min after an exercise session, for example, produces higher ratings of positive affect than assessing affect during the last minute of an exercise session (Parfitt et al., 1994; Parfitt & Eston, 1995). Another study found that mood states appear to be most positive 10-15 min after completion of exercise (Dyer & Crouch, 1988). Because the EFI was given almost immediately after the exercise session with a delay time of no more than 2 or 3 min, the participants might not have experienced the positive effect of the
exercise session. If they had been given a few more minutes to rest, ratings of positive affect might have been higher.

As exercise intensity or duration increases, RPE and affect become more similar (higher for the former and more negative for the latter). Due to the high RPE among most participants, it is not surprising that affect was not more positive during postexercise.

The hypothesis that those in the positive feedback condition would show a decrease in RPE, those in the negative feedback condition would exhibit an increase in RPE, and the RPE of those in the no feedback condition would be similar between pretest and posttest was not supported. RPE increased between pretest and posttest. However, this was seen in all of the groups. As with affect, measured by the EFI, this could have been due to the combined effect of the strenuous exercise and the competitive exercising condition. The RPE has been proposed to be best viewed as “a social psychophysiological phenomenon, the result of active parallel processing involving physiological, cognitive, and affective input” (Hardy & Rejeski, 1989, p. 305; Rejeski, 1985). Thus, the unique effect of feedback on RPE, given the presence of the effects of exercise, hostility, and competitive condition, is difficult to tease out. However, others have argued that physiological sensations, more than affective or cognitive states, determine RPE (Hardy & Rejeski), and as exercise continues, perceived exertion increases (Acevedo et al., 1996). The significant increases in both RPE and heart rate found in this study support this viewpoint. Given the high RPE in all groups, regardless of the feedback they received regarding their performance or whether they received any
feedback at all, it can be assumed that the participants thought the exercise to be fairly strenuous. Hence, exercise, more than other factors, such as feedback and competitive setting, is likely the main causal factor of the increase in RPE between pretest and posttest seen in all groups. Rejeski (1985) argued that physiological cues are most ambiguous in conditions of moderate physical strain. In such a case, others factors, besides physiological cues, may affect RPE. If participants in this study were exercising at a moderate intensity, then the high RPE may be due to other factors besides exercise intensity, such as competition and exercise performance feedback. In fact, it has been documented that only approximately 60% of variability in RPE is due to physiology when exercise is done in the laboratory setting (Morgan, 1973). In this study, exercise intensity was not controlled, but subjective exercise intensity was measured by the RPE. VO\textsubscript{2}max, however, was not measured. Thus, it was not clear exactly what intensity the participants were exercising in because VO\textsubscript{2}max cannot be calculated without speed or participants’ weights, both of which the study failed to obtained. Studies have found that participants perceive exercising on a bicycle to be more difficult than exercising on a treadmill at the same VO\textsubscript{2} (studies cited in Rejeski, 1981). Applying these findings to this study, it is probable that the participants’ work intensity was not as high as they appeared to be, as measured by the RPE. Carver, Coleman, and Glass (1976) found that Type A individuals reported lower fatigue ratings than Type B individuals at the same VO\textsubscript{2}. The fact that hostile participants in this study reported high RPE may indicate that they were truly exercising at a high intensity, especially considering the significant increase in RPE in a short period of merely 5 min between the first and second RPE
rating. A study found effort ratings to be higher after success than failure, which may partially explain the results of this study (Scanlan & Passer, 1980). That is, those in the positive condition gave high RPE ratings due to their successful performance. Those in the negative and no feedback conditions gave high RPE ratings as well, simply due to the effect of fatigue.

The lack of significant differences among the groups on distance biked and the fact that all groups biked further before than after they received feedback, regardless of the feedback they received or if they received any feedback at all, may be due to a number of factors. One factor is a ceiling effect. That is, even if the feedback given to them had influenced their affect, motivation, and physiology, the participants' performance after they received the feedback was worse than before the feedback due to fatigue. Fatigue is a very likely explanation due to the fact those in the no feedback group also biked further prefeedback than postfeedback. Another possibility is the sample size in each treatment condition was too small. Thus, there was not enough power. If the sample size was larger, differences might have been found. Still another explanation may be that the experimental manipulation was ineffective. That is, the participants did not believe the feedback they received regarding their exercise performance.

The same factor for the lack of significant findings on distance may also explain the lack of significant findings on physiological reactivity. It may be that reactivity due to the feedback was present, but masked with a natural increase in heart rate and blood pressure normally seen when one exercises. If reactivity caused by the feedback was, in
fact, present, the lack of significant differences among the group could have been due to the possibility that these hostile students reacted competitively in a competitive situation, regardless of the type of feedback they received or whether or not they received any feedback at all. Some studies have, indeed, found that hostile individuals react to all levels of stressors, including daily routine (e.g., Dembroski et al., 1979; Pope & Smith, 1991). That is, it may be that those in the negative feedback condition exhibited a higher increase in blood pressure and heart rate than those in the positive feedback condition as a result of the feedback they received, but because both groups were exercising very hard, an added increase in reactivity in the negative group due to the feedback was not much more significant than the increase in the positive group that was due to exercise alone. Another explanation is that the treatment had no effect on these participants’ physiological reactivity. Still another reason is that the sample size is too small for any differences to be detected.

The nature of this study made it very difficult to detect any treatment effect. Because it is a study of the effects of exercise performance feedback on affect, physiology, and exercise behavior, it was very difficult to separate the effects of feedback from the effects of exercise. For example, research has found that exercise alone affects one’s mood state, as measured by the EFI. Research has also found that interpersonal stressors affect mood state. When interpersonal stressor is provided in the context of exercise, it is almost impossible to attribute any outcome to either the stressor, exercise, or both. Fatigue due to ceiling effect could also have affected participants’ RPE. Regardless of whether one received positive, negative, or no feedback, the RPE was
assessed to be high due to the effect of exercise. Another example is physiology. 
Unquestionably, exercise alone affects heart rate and blood pressure. Research has also 
found that interpersonal stressors affect heart rate and blood pressure. Again, when both 
interpersonal stressors and exercise are at work, such as during the second half of the 
exercise session after the feedback was given, the effects of feedback could have been 
concealed by the effects of exercise, making any changes in physiology to be 
undetectable. Thus, it was not surprising that no differences were found among the 
groups.

Limitations of the Study

Attempts were made to control for extraneous physiological factors by asking 
participants to get a good night’s sleep, not eat a heavy meal, and not exercise before 
coming in. However, the participants’ experience before coming into the lab will differ 
among individuals. Individuals differences, such as self-efficacy, needless to say, 
existed. It is assumed, however, these prior differences were controlled by random 
assignment into the conditions. Future studies could examine how individual differences, 
such as self-efficacy, interact with feedback to affect one’s exercise behavior, affect, and 
physiological reactivity.

Having different research assistants run the experiments could have potentially 
affected the results of the study. However, the research assistants were randomly 
assigned to each participant. The number of conditions they ran and the order in which 
they ran the experiments was controlled. That is, each researcher ran the same number of
participants in each condition, and the number of men and women they ran was also balanced. They ran each condition, according to gender and feedback condition. For example, if a researcher ran a female participant in the positive feedback condition, she would put the next female participant in the negative feedback condition, and the one after that would be in the no feedback condition. The procedure was the same for assigning the male participants. This method was used to further ensure consistency and reduce extraneous variability among groups.

To ensure consistency across researchers and conditions, the research assistants were given a research protocol in which the entire procedure was written out step by step. This may minimize variability. However, what actually happened during each experiment is difficult to evaluate. A way to assess the consistency among groups would be to have the research assistants document events that might influence the outcome of the experiment or to videotape each session and have raters assess experiment integrity.

Testing effect may be a threat in this study. Having filled out the measure during the pretest could have affected the participants to respond differently than they otherwise would have during the posttest, had they not taken the test before. They could have responded similarly to maintain consistency or randomly due to the boredom of having to fill out another one of the same measures as in the pretest or to fatigue from the exercise. However, it is assumed that the threat of testing affected all participants similarly, regardless of the group they were in.

The groups were selected according to their scores on the Cook-Medley Hostility Inventory. Thus, the individuals were all supposed to be hostile. However, there is
variability within the group, in that some individuals were more hostile than others. Stratification by ensuring that each of the three conditions has equal members of "more hostile" participants, as well as "less hostile" participants, could have reduced this variability. However, random assignment of the participants to the treatment conditions reduced this threat. The cutoff score for inclusion into the study was $22, M = 26.71, SD = 4.6$. These scores are higher, if not similar to the mean scores found in many of the previous studies that found hostility to be a predictor of various outcomes (e.g., 28.1, Pope et al., 1991; 16.1, Shekelle et al., 1983; 15, Siegler et al., 1992). Thus, it may not be a question of whether the participants were truly hostile enough to have reacted to the particular stressor of exercise performance feedback, but whether the stressor was stressful enough to have elicited any responses from these hostile participants.

The mean score of the positive and negative feedback groups' ratings of the believability of the feedback given to them was relatively low—around 3, which corresponds to "somewhat believable." This raised the concern of treatment validity. Unfortunately, treatment validity could not be accurately assessed by the believability scale. The wording of the question on the believability scale is problematic, and, thus, may be a reason why the believability scale was not the best instrument in assessing treatment validity. Although it asked the participants to rate how believable they thought the feedback given to them was, many of the participants rated the believability based on how they were feeling at the moment. It appeared that both groups of people justified their choice by how worn out they were feeling at the end of the biking session. For example, many of the participants in the positive feedback condition stated in the open-
ended question of the believability scale that they found the feedback given to them to be highly believable because they felt that they had biked hard and were feeling very exhausted. Some stated that the reason why they did not find the feedback believable was because they were feeling too worn out and could not have possibly done so well as reported. Similarly, those in the negative feedback condition who found the feedback believable indicated that, based on how tired they were, the figured they had not done well. On the other hand, those who did not find the feedback believable felt that they must have done better than indicated due to the fact that they had worked hard and were feeling very tired.

It is also possible that the participants were reluctant to endorse extreme items. Thus, the item in the middle of the scale, “somewhat believable” was endorsed most often. This was seen in some inconsistency between the rating of the feedback and the open-ended information they provided. For example, some participants indicated that they thought the feedback was believable, but circled “somewhat believable,” nevertheless.

It may have been that the participants found the feedback believable enough for it to have an effect on their exercise behavior, but they were reluctant to admit it for fear of appearing having been misled. Another possibility is that the feedback had an effect on the participants’ behavior without their realization. One of the participants reported that he did not believe the feedback, but he worked harder because it “made [him] angry” and that he felt like he was being “chewed out.” Another stated that he did not believe he was
competing with his peers, but because of his "competitive nature," it made him "try harder."

The believability scale could have been a better measure had it been worded differently and if an additional question of how the feedback had affected the way they exercised was included.

Future research could ensure that the feedback is effective by providing it in such a way that is more believable. Increasing the sense of competition may add to the believability of the feedback and experiment. In order for this to happen, the feedback would need to be more personally relevant and given in a more emphatic way.

Another major shortcoming of the study was that it is difficult to separate the effect of exercise from the effect of the feedback. Reducing the intensity and length of exercise may prevent the ceiling effect, resulting from intense exercising before feedback is given, leading to fatigue. With less fatigue, participants may be able to exercise harder, if they choose to, after feedback is given.

Although the groups were similar in fitness level, individual differences did exist. It would be interesting to investigate whether feedback has different effects on people of different fitness level. Parfitt and Eston (1995) found that individuals who were more physically active maintained a similar affect (positive) as duration and intensity increased, whereas those who were less active showed an increase in negative affect with increased duration and intensity. Another study found that active men experienced greater reductions in depressed feelings than sedentary men in response to acute exercise (Steptoe, Kearsley, & Walters, 1993). Future research could also examine relations
between physical fitness and the other variables examined in this study in the same context of exercise feedback, competitive setting, and hostility.

The determination of exercise intensity was based on a small-scale pilot test and a consultation with exercise instructors. Although participants were assessed to be average to above-average in fitness level by the fitness test, it appeared that the bike exercise was more than an exercise at a moderate intensity for most of the participants. Hostility and competitiveness could be influential factors that led them to exercise at a greater-than-moderate intensity. Future studies could determine the specific length of time, resistance, and RPE fitting as moderate intensity, and higher RPE could be interpreted as participants exercising at a greater than moderate intensity due possibly to hostility and competition. Participants' VO$_2$max should also be determined.

The validity of the physiological data (heart rate and blood pressure) obtained is questionable. Although the small drop in systolic blood pressure between rest and exercise is not unusual, the low measures of diastolic blood (below 70 mmHg) pressure during rest and, especially, during exercise are atypical. The unreliability of the machine is suspected to be the reason for these unusually low data. Thus, the means should be interpreted with caution. However, because the low data was observed in all three groups (i.e., no group main effect), the group and time main effects and the interaction effect may be valid.

Although having the experiment in a laboratory versus a natural setting gave the experimenter more control, exercising in such an environment led participants to feel that the situation was unrealistic and, hence, might have affected the results of the experiment.
For example, the lack of significant findings in affect could have been due to the exercise environment. Gauvin et al. (1996) observed that the positive increase in positive affect and the decrease in negative affect are often seen in natural exercise settings, but are rarely seen in unnatural conditions, such as laboratories.

Relations among the various variables in this study—EFI, RPE, distance, heart rate, and blood pressure—were not statistically examined, although it is assumed that the relations should all be similar. For example, a low EFI scores should correspond to a high RPE score, and a high RPE score with high physiological reactivity scores. Future studies including the same variables could analyze them statistically.
REFERENCES


APPENDICES
Appendix A: Informed Consent

Date Created: 9/1/00

Informed Consent
Exercise and Physiological Response Among College Students.

Introduction/Purpose
You have been asked to take part in a research study conducted by the Department of Psychology to find out more about how exercise affects one's physiology and feeling states. It is an ethical principle that the participants in a study be informed of the purpose and benefits of the project; the research methods to be used; the potential risks or hazards of participation; and the right to ask for further information at any time during the research procedures. Your choice to participate is a voluntary one, and you are free to withdraw from the research project at any time without consequence. Your signature at the end of this consent form will indicate that the principal investigator, or his/her research assistant, has answered all your questions and that you voluntarily consent to participate in this investigation.

Procedures
If you agree to be in this study, you will be asked to fill out three questionnaires, walk on a treadmill for 8 minutes, and bike on a bicycle ergometer for approximately 15 minutes. Your heart rate and blood pressure will also be assessed. The entire research session will take approximately 1 hour.

Risks
Participation in this study may involve some risks or discomforts. These include:

1. being attached to a heart rate monitor and a blood pressure cuff while exercising
2. feelings of fatigue from the exercise sessions

You should not participate if you are pregnant, have asthma, a heart condition, or any other conditions that may prevent you from exercising in a moderate intensity for about 25 minutes.

Care if Harmed
If you are injured as a direct result of participation in this study, Utah State University is not responsible for any medical care you may require. The University will not provide any other form of compensation to you if you are injured. You may call the Institutional Review Board (IRB) at (435) 797-1180 for more information about your rights as a research participant or research-related injured.
Informed Consent
Exercise and Physiological Response Among College Students.

Confidentiality
Information related to you will be treated in strict confidence to the extent provided by law. Your identity will be coded and will not be associated with any published results.

Your code number and identity will be kept in a locked file of the principal investigator and only the investigator, her advisors, and her research assistants will have access to the data.

Benefits
Your participation in this study will contribute to existing knowledge regarding exercise, physiological reactivity, and affect. It will be invaluable and greatly appreciated.

IRB Approval Statement
The Intuitional Review Board (IRB) for the protection of human subjects at Utah State University has reviewed and approved this research project.

Explanation and offer to answer questions
If you have additional questions about this study or your rights, or if any problems arise, you may contact Kevin Masters, Ph.D. at 797-1463 or Crystal Lin at 797-5824. Your participation in this study is voluntary and you may discontinue your participation at any time without consequence and without affecting future services that you would otherwise receive.

You have been given two copies of this Informed Consent. Please sign both copies and retain one copy for your files.

I have read and understand this Consent Form and I am willing to participate in the study.

Name of Participant ____________________________

Signature of Participant ____________________________ Date ____________
Informed Consent
Exercise and Physiological Response Among College Students.

**Investigator Statement**
I certify that the research study has been explained to the above individual, by me or my research assistant, and that the individual understands the nature and purpose, the possible risks and benefits associated with taking part in this research study. Any questions that have been raised, have been answered.

Kevin Masters, Ph.D.
Principal Investigator
797-1463

Crystal Lin
Student Researcher
797-5824
Appendix B: Experimental Protocol

**During Scheduling**

Remind participant the following:
1. wear exercise clothes and shoes
2. bring clothes to change (may take a shower afterwards)
3. get a good night’s sleep
4. don’t eat a big meal before exercise
5. don’t exercise before coming in.
6. HPER 152 (the Wellness Center)
7. give your phone # and email in case they need to reschedule or cancel

**Research Protocol**

**Before participant comes in**

Have materials ready.
Set up equipments.
Set treadmill to 0% grade.
Cover screen on bike. Reset distance reading.
Set BP machine to inflation 150, deflation 3.
Take room temperature and humidity.
Towels

**Activity**

Administer 2 Informed Consents (give 1 to them, keep the other).

Put HR monitor around abdomen and BP monitor cuff around arm. Take off watch.

Administer Exercise Induced Feeling Inventory (EFI). Indicate #1 on page and condition (type of feedback).

Have them sit for three minutes. Read magazines.

Take resting Blood Pressure (BP) and Heart Rate (HR). Make sure person’s sitting down, arm resting on table, palm facing up. Turn machine away so person can’t see readings.
Take BP cuff off, but leave HR monitor strap around abdomen on.
Introduce Rating of Perceived Exertion (RPE). Read instructions to them. Also use RPE board.

Ask fitness questions to determine fitness level (for treadmill speed). Record response on fitness test page. “How much do you exercise on a weekly basis? What type(s) of exercise? How many times a week? How many hours each week? On average, what is your RPE on those activities? When was the last time you exercise? How many hours of sleep last night? How fit do you think you are compared to other men/women your age? What is your age?”

Treadmill Speed: 3 unfit-average (e.g., does not exercise much) 3.5 somewhat fit (e.g., 2-3 hours/week) 4 very fit (e.g., hike, swim, jog for hours; run the marathon)

Determine target HR range

<table>
<thead>
<tr>
<th>age</th>
<th>HR range</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>101-141</td>
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<tr>
<td>19</td>
<td>101-141</td>
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<tr>
<td>20</td>
<td>100-140</td>
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<td>21</td>
<td>100-139</td>
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<td>22</td>
<td>99-139</td>
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<td>23</td>
<td>99-138</td>
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<td>24</td>
<td>98-137</td>
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<td>25</td>
<td>98-137</td>
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<td>26</td>
<td>97-136</td>
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<tr>
<td>27</td>
<td>97-135</td>
</tr>
<tr>
<td>28</td>
<td>96-134</td>
</tr>
</tbody>
</table>

Fitness test

Adjust speed. Turn belt on first.

Instructions: “I’m going to assess your fitness level by having you walk on this treadmill for 8 minutes, first at a 0% grade and then it’ll be raised up to a 5% grade”

Demonstrate on treadmill. Can hold onto bar until feel comfortable. If have trouble during walking, may hold onto bar. If HR too low on range after HR2 determined, raise speed (let them know will increase speed. Have them continue walking while adjusting speed. Don’t stop belt.)

Fitness test (0% grade)
Fitness test (5% grade)

Let them know adjusting grade to 5% and should hold onto bar. Don’t stop belt and have them continue walking. Let them know stopping belt at end and should hold onto bar.

Rest for 10 minutes. Read magazines. Put on BP cuff. Take 2nd readings of resting BP and HR at end before getting up.

Sit on bike, adjust seat and bike handle bar. Make sure comfortable. Give instructions to bike test.

Instructions: “I would like you to bike for 10 minutes. Please work hard because you’re competing with other college students.”

Bike for 5 minutes (if they ask how much longer, don’t tell them. Tell them to continue to do their best)

Switch inflation to 210, deflation to 5. Turn machine away from participant’s view (on bike).

Stop biking. Before taking BP: Rest arm on bike handle. Turn palm up. Adjust cuff. Take BP, HR, RPE, distance biked.

Look at fitness table and give feedback

Feedback:

No Feedback Condition: none

Positive Feedback Condition: “I’m looking at this chart of biking times, and you’re doing better than 80% of other college students at the rate you’re going. Keep up the good work.”

Negative Feedback Condition: “I’m looking at this chart of biking times, and you’re doing worse than 80% of other college students at the rate you’re going. You really need to work harder”

Bike for another 5 minutes.

Stop biking
Take BP, HR, RPE (2nd half, after performance feedback given) and distance biked

Take off HR monitor around abdomen.

EFI. Indicate #2 on page.
Believability measure

Debrief. Emphasize not sharing anything with other students. Don’t let them take debrief sheet home. Have them call Crystal if have questions.

Wipe BP cuff with wet paper towels and rinse BP monitor strap.

***make sure ID is on all materials.
Appendix C: Cook-Medley Hostility Scale

This inventory consists of numbered statements. Read each statement and decide whether it is true as applied to you or false as applied to you. If a statement is true or mostly true, as applied to you, circle the word True next to the question. If a statement is false or not usually true, as applied to you, circle the word False next to the question. If a statement does not apply to you or if it is something that you don’t know about, do not circle either True or False. But try to give a response to every statement. Remember to give your own opinion of yourself.

1. When I take a new job, I like to be tipped off on who should be gotten next to. True False
2. When someone does me a wrong I feel I should pay him back if I can, just for the principle of the thing. True False
3. I prefer to pass by school friends, or people I know but have not seen for a long time, unless they speak to me first. True False
4. I have often had to take orders from someone who did not know as much as I did. True False
5. I think a great many people exaggerate their misfortunes in order to gain the sympathy and help of others. True False
6. It takes a lot of argument to convince most people of the truth. True False
7. I think most people would lie to get ahead. True False
8. Someone has it in for me. True False
9. Most people are honest chiefly through fear of being caught. True False
10. Most people will use somewhat unfair means to gain profit or an advantage rather than to lose it. True False
11. I commonly wonder what hidden reason another person may have for doing something nice for me. True False
12. It makes me impatient to have people ask my advice or otherwise interrupt me when I am working on something. True False
important.

13. I feel that I have often been punished without cause.  True  False

14. I am against giving money to beggars.  True  False

15. Some of my family have habits that bother and annoy me very much.  True  False

16. My relatives are nearly all in sympathy with me.  True  False

17. My way of doing things is apt to be misunderstood by others.  True  False

18. I don’t blame anyone for trying to grab everything he can get this world.  True  False in

19. No one cares much what happens to you.  True  False

20. I can be friendly with people who do things which I consider wrong.  True  False

21. It is safer to trust nobody.  True  False

22. I do not blame a person for taking advantage of someone who lays himself open to it.  True  False

23. I have often felt that strangers were looking at me critically.  True  False

24. Most people make friends because friends are likely to be useful to them.  True  False

25. I am sure I am being talked about.  True  False

26. I am likely not to speak to people until they speak to me.  True  False

27. Most people inwardly dislike putting themselves out to help other people.  True  False

28. I tend to be on my guard with people who are somewhat more friendly than I had expected.  True  False

29. I have sometimes stayed away from another person because I feared doing or saying something that I might regret afterwards.  True  False
30. People often disappoint me. True False

31. I like to keep people guessing what I'm going to do next. True False

32. I frequently ask people for advice. True False

33. I am not easily angered. True False

34. I have often met people who were supposed to be experts who were no better than I. True False

35. I would certainly enjoy beating a crook at his own game. True False

36. It makes me feel like a failure when I hear of the success of someone I know well. True False

37. I have at times had to rough with people who were rude or annoying. True False

38. People generally demand more respect for their own rights than they are willing to allow for others. True False

39. There are certain people whom I dislike so much that I am inwardly pleased when they are catching it for something they have done. True False

40. I am often inclined to go out of my way to win a point with someone who has opposed me. True False

41. I am quite often not in on the gossip and talk of the group I belong to. True False

42. The man who had most to do with me when I was a child (such as my father, stepfather, etc.) was very strict with me. True False

43. I have often found people jealous of my good ideas, just because they had not thought of them first. True False

44. When a man is with a woman he is usually thinking about things related to her sex. True False

45. I did not try to cover up my poop opinion or pity of a person so that won't know how I feel. True False

46. I have frequently worked under people who seem to have True False
things arranged so that they get credit for good work but are able to pass off mistakes onto those under them.

47. I strongly defend my own opinions as a rule.       True   False

48. People can pretty easily change me even though I thought that my mind was already made up on a subject.       True   False

49. Sometimes I am sure that other people can tell what I am thinking.       True   False

50. A large number of people are guilty of bad sexual conduct.       True   False
Appendix D: Exercise-induced Feeling Inventory

Please use the following scale to indicate the extent to which each word below describes how you feel at this moment in time. Record your responses by circling the appropriate number next to each word.

<table>
<thead>
<tr>
<th>Word</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refreshed</td>
<td>DNF</td>
</tr>
<tr>
<td>Calm</td>
<td>0</td>
</tr>
<tr>
<td>Fatigued</td>
<td>1</td>
</tr>
<tr>
<td>Enthusiastic</td>
<td>2</td>
</tr>
<tr>
<td>Relaxed</td>
<td>3</td>
</tr>
<tr>
<td>Energetic</td>
<td>4</td>
</tr>
<tr>
<td>Happy</td>
<td>5</td>
</tr>
<tr>
<td>Tired</td>
<td>6</td>
</tr>
<tr>
<td>Revived</td>
<td>7</td>
</tr>
<tr>
<td>Peaceful</td>
<td>8</td>
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</tbody>
</table>

0= Do Not Feel (DNF)
1= Feel Slightly
2= Feel Moderately
3= Feel Strongly
4= Feel Very Strongly (FVS)
<table>
<thead>
<tr>
<th>No.</th>
<th>Theme</th>
<th>Rating</th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Worn-out</td>
<td>DNF 0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>Upbeat</td>
<td>DNF 0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Appendix E: Borg’s Rating of Perceived Exertion Scale

During the exercise we want you to rate your perception of exertion. We want you to use this rating scale where 6 means no exertion at all and 20 means a maximal exertion. 9 is a very light exercise, like walking slowly for some minutes (for healthy people). 13 on the scale is a somewhat heavy exercise but it still feels fine and you should not have any problems to continue exercising. When you come to 17, “very hard”, it is really very strenuous, you can still go on but you have to push yourself very much. 19 on the scale is an extremely strenuous exercise. For most people this is an exercise as strenuous as they have ever experienced before.

Try to appraise your feeling of exertion as honestly as possible. Don’t underestimate it, but don’t overestimate it either. Some people are a bit insensitive or want to be “brave” and rate too low. Don’t do that but try to feel your exertion as your perceive it. Don’t bother about how heavy the load is physically or what the exercise objectively might be. We are only interested in your own feeling of effort and exertion. Look at the scale and the wordings and then give us a number. You can equally well give us an even as an odd number.

6  No exertion at all
7  Extremely light
8
9  Very light
10
11  Light
12
13  Somewhat hard
14
15  Hard (heavy)
16
17  Very hard
<p>| | |</p>
<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Extremely hard</td>
</tr>
<tr>
<td>19</td>
<td>Maximal exertion</td>
</tr>
</tbody>
</table>
Appendix F: Believability Scale

Believability Assessment

To what extent did you believe the evaluation of your performance given to you while you were biking? Please circle the number.

<p>| | | | | |</p>
<table>
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<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Not at all believable</td>
<td>Somewhat believable</td>
<td>Completely believable</td>
<td></td>
<td></td>
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</tbody>
</table>

Do you think the evaluation of your performance given to you while you were biking was believable? Why or why not?
Debriefing Information 9/1/00

You have just participated in a study conducted on exercise. This will tell you more about the study and answer any questions that you may have. The purpose of the study is to find out what effect feedback regarding one’s exercise performance has on physiological reactivity (heart rate and blood pressure), perceived exertion, and feelings among hostile college students. When you came into the lab, your fitness level was first assessed using the treadmill. You were then asked to bike on the bicycle ergometer for 15 minutes, during which feedback regarding your performance compared to that of other students was given. The feedback given to you was false. That is, your performance was never compared to anyone else’s. It is not the purpose of the study to compare your performance with anyone else’s. Rather, the true purpose of the study, as mentioned earlier, was to find out how certain types of feedback affect the way people react physiologically, perceive their level of exertion, and feel after they exercise.

It is very important that you share none of this information or experience with other students as this will affect the outcome of the study. Your participation in this research will contribute to an important area in the field of Health Psychology. We thank you very much for your participation. If you have any more questions regarding the study, please feel free to contact Crystal Lin at 797-5824.

Sincerely,

Crystal Lin