# AFFECTIVE STATE RESPONSE TO STRETCHING BEFORE AN ACUTE BOUT OF EXERCISE

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# CHAPTER I

## INTRODUCTION

Lack of physical activity is currently a major concern in our nation (45). Our government has constantly intervened in this matter for the past three decades and currently has proposed the most recent version of Healthy People 2010. According to the official website (46) there are two main goals for Healthy People 2010. These goals are increase quality and years of healthy life and eliminate health disparities. The US Department of Health and Human Services, USDHHS, (44) is the official coordinator of meeting these two goals along with the help from other federal agencies, businesses, and communities. By having the support federally, local communities can identify ways to incorporate health into their own population. According to the USDHHS (44), anyone can benefit from physical activity. Physical activity can prevent some of the following disparities- coronary heart disease, stroke, type II diabetes, colon cancer, and depression (44). Preventing these diseases and conditions can increase the quality and years of healthy life. Therefore, physical activity is a major contributor to improving the quality of life in our nation.

According to the U.S. Physical Activity Statistics database (45), more than 50% of American adults do not get enough physical activity to experience health benefits. Among this 50% of the population, 25% of these people do not engage in any activity

during their leisure time. The database also reports statistics stating that a third of young people in grades 9-12 do not engage in intense/vigorous exercise coupled by a drop in daily participation in physical education class. These facts provide motive towards the two goals stated previously in Healthy People 2010.

If over half of the American adult population remains inactive, how can professionals in the field of health and exercise motivate these people to get moving? One theory/remedy is positive behavior change. Psychologist Albert Bandura believed that changing behavior depended partly on the concept of self-efficacy. According to Bandura self-efficacy is "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (37). Increasing an individual's self-efficacy will likely increase the probability that the current task will be completed. The concept of self-efficacy can be applied to the fields of health and exercise.

An individual's belief about their efficacy can be strongly developed by four main sources of influence—mastery experience, vicarious experience, social persuasion, and emotional states (37). The most effective way of creating a strong sense of efficacy is through mastery experiences. Success at task builds efficacy while failure destroys it.

Creating a mastery experience is the challenge for those who motivate the unmotivated. How would someone create a successful mastery experience? The literature reviewed in Chapter II of this study examines ways to increase mastery experience particularly how stretching before exercise influences an individual's self-efficacy and state anxiety. This study will also explore the physiological effects of pre-exercise stretching and its influence on performance. If stretching before exercise shows

no significant increase in physical performance, then can it be used to increase self-efficacy? This question will also be addressed in this study.

By exploring new methods to motivate the majority of the population, health professionals can vary their technique with increased success. Each person has a custom set of needs. By meeting these needs, persons will be more likely to try activities out of their comfort zone. Increasing self-efficacy and decreasing state anxiety can provide the catalyst that engages people to make a behavior change and adopt a more active lifestyle.

## Statement of the Problem

The problem in this study was to examine the influence of stretching before an acute bout of exercise has on affective states in male and female subjects between the ages of 18 and 24 years. The researcher compared the subjects' scores of two experimental sessions—one with pre-exercise stretching and one control that substituted reading a professional cycling article for stretching. The State Trait Anxiety Inventory (STAI) was used to measure levels of anxiety before and after each of the two experimental sessions. The Acute Exercise Self-Efficacy Questionnaire was used to measure self-efficacy before each of the two experimental sessions**.**

## Purpose of the Study

Recently arguments have been made against incorporating stretching as part of the warm-up before an acute bout of exercise. Research has been conducted exploring the physical benefits of pre-exercise stretching and regular/routine stretching. Less research has been conducted on the affective benefits of pre-exercise stretching

before an acute bout of exercise. If pre-exercise stretching provides little or no benefit in physical performance, then can it increase self-efficacy which in turn increases exercise adherence? Specifically, what effects does stretching before a bout of exercise have on self-efficacy and state anxiety levels? The purpose of the present study was to explore and evaluate this latter question. It was the goal of the researcher to 1.) identify a way to increase exercise self-efficacy 2.) identify another strategy to decrease an individual's state anxiety level prior to exercise.

## Significance of the Study

Professionals in health and exercise can offer individuals strategies and techniques to customize a regular physical activity program. New methods for increasing exercise adherence are introduced often, however, the majority of these methods offer a quick fix to an underlying problem of low self-esteem. Individuals with low self-esteem are less likely to have high task performance, in this case self-efficacy. Increasing self-efficacy will allow for individuals to have a positive mastery experience and hopefully adopt a regular physical activity program (3). Based on the investigator's experience with students and athletes, the importance of task mastery as a motive for regular exercise has become an imperative part of experiencing a successful behavior change. Since the present study explores an alternative way to increase self-efficacy for exercise, health and fitness professionals could use pre-exercise stretching as a way to prevent state anxiety towards physical activity. If pre-exercise stretching statistically proves to be a significant intervention for physical activity, then health and fitness professionals can provide

individuals with an additional strategy to improve their activity levels eliminating health disparities and increasing the overall quality of life.

## Assumptions

The following assumptions were made:

1. Results of the STAI were an accurate reflection of subjects' anxiety at the time of completion.
2. Results of the Acute Exercise Self-Efficacy Questionnaire were an accurate reflection of subjects' self-efficacy at the time of completion.
3. The subjects were honest when completing the Physical Activity Readiness Questionnaire (PAR-Q).
4. The subjects were honest and accurate when reporting that they were moderately active prior to participation in the study.

## Limitations

The research may be limited by the following:

1. The STAI is a self-report survey.
2. The Acute Exercise Self-Efficacy Questionnaire is a self-report survey.
3. Each subject attended two experimental sessions at least 48 hours apart. The only difference between the two sessions is the pre-exercise stretching intervention. There could perhaps be a threat to the internal validity of this design due to the fact the subject had already been exposed to the testing protocol before their second session.

## Delimitations

1. Subjects recruited for this study were male and female students at Oklahoma State University between the ages of 18 and 24 years.
2. Subjects that volunteered for this study were required to complete the PAR-Q prior to participation in this study, with the understanding that any subject who showed contraindications to physical activity based on the PAR-Q would be excluded from the study.
3. Subjects were limited to individuals who indicated that they were currently moderately active for at least 3 hours per week and also a nonsmoker.
4. Data was collected from subjects on two occasions.

## Hypotheses

The following null hypotheses were investigated:

$H_o1$: There will be no significant differences in the subjects' STAI scores between the experimental and control session.

$H_o2$: There will be no significant differences in the subjects' Acute Exercise Self-Efficacy Questionnaire scores between the experimental and control session.

## Definition of Terms

Acute Exercise—Acute exercise is a single bout of moderate-intensity aerobic exercise (35).

Acute Stretching—Acute stretching is stretching immediately before physical activity (30).

Affect—Affect in the context of affective is "a term denoting broad psychological states of positive and negative feelings that change from moment to moment" (42).

Cycle ergometry—The type of cycle used for this study was the Monark Cardio Care 827E cycle ergometer. Cycle ergometry involves the use of a stationary bicycle that is equipped with a device that is capable of eliciting and measuring varying workloads; it allows for user friendly adjustments of workload (40).

Dynamic Stretching—Dynamic Stretching is sometimes referred to as ballistic stretching which involves dynamic muscle action whereby the muscles are stretched suddenly in a bouncing movement (41).

Emotional States—According to Bandura, "Positive mood enhances perceived self-efficacy, despondent mood diminishes it. The fourth way of modifying self-beliefs of efficacy is to reduce people's stress reactions and alter their negative emotional proclivities and misinterpretations of their physical/emotional states" (3, 4).

Exercise— Exercise in the context of this study is defined as "Planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness" (40).

Exercise Adherence—Individuals who are highly self-motivated are inclined to adhere to self-monitored exercise programs longer than those who are not highly self-motivated (36).

Flexibility—Flexibility is the ability of a joint to move through its full range of motion. Flexibility can be increased thorough stretching exercises for all major joints (41).

Force—Force as used in the context of exercise physiology is an influence that produces a change in a physical quantity; "force equals mass times acceleration," (40).

Mastery Experience—Past success raises self-efficacy; past failure lowers self-efficacy (3).

Moderately Active—Requirements for this study included moderately active subjects. According to ACSM, moderately active is participation in physical activity on at least three days per week, for at least 30 minutes per bout, and at a moderate level of intensity (a HR of 64-76% of max). Generally speaking, moderate intensity would be comparable to walking 3 to 4 miles per hour (40). For the present study, the intensity of the cycling time trial was measured using hear rate at every minute of the staged protocol and with Borg's Rate of Perceived Exertion Scale (RPE). Predicted maximal heart rate can be calculated by subtracting a person's age from 220 (42).

Physical Activity—A general definition for physical activity is "Bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure" (40).

Physical Activity Readiness Questionnaire (PAR-Q)—This questionnaire is designed to identify individuals who have contraindications to increasing levels of physical activity and who should seek medical clearance from a physician before becoming more active (40). It was used as a screening tool for subjects who did not qualify for this study.

Physical fitness—This term is used in the context of exercise adherence. Physical fitness is "A set of attributes that people have or achieve that relates to the ability to perform physical activity" (40).

Power--Power is a direct measure of the force applied (torque), that is converted into a measure of power output (watts) (30).

Pre-Exercise Stretching— The importance of stretching prior to exercise is reflected in the fact that almost all structured exercise programs advocate the inclusion of callisthenic exercises prior to the commencement of aerobic exercise (41).

Proprioceptive Neuromuscular Facilitation (PNF)—PNF techniques use reflexes initiated by muscle and joint receptors to cause greater training effects. One method is the

contract-relax stretching method, in which a muscle is contracted before it is stretched (41).

Range of Motion--Range of motion is the normal range of movement for a joint, specifically flexion and extension (41).

Self-Determination—Self Determination is "the ability to identify and achieve goals based on a foundation of knowing and valuing oneself," (37).

Self-efficacy—According to psychologist Albert Bandura, is defined as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives. Self-efficacy beliefs determine how people feel, think, motivate themselves, and behave." Self-efficacy derives from four main sources of influence—mastery experience, vicarious experience, social persuasion, and emotional states (37).

Self-Regulation—"Self-regulation is defined by the recourse to voluntary norms which are developed and accepted by those who participate in a determined activity" (37).

State-Trait Anxiety Inventory (STAI)—This particular survey is designed to measure anxiety and includes two scales—one to measure state anxiety and another to measure trait anxiety. The State Anxiety scale is used to assess how anxious a person feels at that moment while the Trait Anxiety scale is used to assess a person's general level of

anxiety. Each scale contains 20 statements, and individuals completing the STAI are asked to indicate how well each statement relates to them on a scale of 1 to 4, with 1 being "not at all" and 4 being "very much so" (38, 39).

State Anxiety—According to Spielberger, "State anxiety is defined as an unpleasant emotional arousal in face of threatening demands or dangers" (47).

Static Stretching—Each muscle is gradually stretched, and the stretch is held for 10-30 seconds. This should be done to the point where tension is felt, but not to the point of pain (41).

Time Trial- Time trials are generally started at preset intervals and held on an out-and-back or circuit course, and are generally 15 or 40 km, but dozens of lengths are sanctioned (Velo News, 2002). In the case of this study a time trial is an almost maximal exertion on the stationary bike in which the rider attempts to travel the most distance over a set amount of time.

Verbal Persuasion-- Social persuasions relate to encouragements/discouragements. These persuasions can have a strong influence on confidence. Positive persuasions increase self-efficacy, negative persuasions decrease it. It is generally easier to decrease someone's self-efficacy than it is to increase it (3).

Vicarious Experience-- This is a process of comparison between a person and someone else. When a person sees someone succeeding at something, their self-efficacy will increase; and where they see people failing, their self-efficacy will decrease (3).

VO2 Max—The maximum capability of an individual to consume oxygen. This is highly related to that individual's ability to perform work over prolonged periods (41).

# CHAPTER II

# REVIEW OF LITERATURE

## Introduction

Recent studies in the exercise world have yielded findings which fail to elucidate the benefits stretching was once thought to produce (1, 29, 30, 33). This position stand has resulted in portions of the exercise population eliminating all forms of stretching during exercise prescription (16). Previous to the current trends, certain benefits of performance were attributed to stretching before and after exercise due to increases in force and power (29). The majority of the exercise population relates stretching to the prevention of acute and chronic physiological injuries. If stretching does not improve physical performance, it will most likely become a neglected part of the pre-exercise routine within the active population.

The majority of research concerning pre-exercise stretching is primarily concerned with the physiological benefits it can produce (30). There are few studies that have examined how pre-exercise stretching can influence the areas of self-efficacy, mood states, and mastery (28, 29). Therefore, little or no evidence exists exploring the unique relationship between stretching and the affective domain of exercise; thus, stretching may be used to increase certain areas of performance affectively.

The scholarly literature on stretching and self-efficacy was identified using on-line database searches facilitated by the Oklahoma State University Library, including ProQuest, PubMed, and JAMA. These databases provide access to abstracts and full-text articles, as well as books, doctoral dissertations, and conference proceedings, relating to sports medicine and athletics. For this specific review, searches were limited to research findings published since 1980, with the exception of two articles (3, 26), including reviews of earlier research. The keywords used in the search were limited to the following: "self-efficacy", "self-efficacy and exercise", "self-regulation", "self-determination", "exercise adherence", "stretching as an intervention", "stretching and injury prevention" "stretching and performance". Special emphasis was placed on identifying research on heterogeneous populations and on those sources which discuss the possible mechanisms of interventions that improve self-efficacy. Articles published in languages other than English or in non-peer reviewed format were not considered.

Self-Efficacy Increases Task Performance

Behavior is a mechanism from which all areas of performance can be assessed. An individual's behavior before, during, and after an activity will vary depending on numerous factors. Current components of self-efficacy derived from research conducted in the late 1970's by psychologist Albert Bandura and in his article "Self-efficacy: Toward a Unifying Theory of Behavioral Change." Self-efficacy is an individual's estimate of his ability to cope with a situation, and his/her outcome expectancy, and/or, an individual's estimate of the likelihood of certain consequences occurring. According to Bandura and businessman Edwin Locke (2, 3), productivity can be influenced the most

before the task is attempted. The influence of self-efficacy on performance has been widely researched in almost every domain of the behavioral sciences (2, 4). The theory of self-efficacy was refined by Bandura ten years later by situating it within a social cognitive theory of human behavior. Following these research theories came a multitude of research that explored the affects of self-efficacy on various behaviors, these include: depression (Davis & Yates, 1982); stress (Jerusalem & Mittag, 1995); smoking (Garcia, Schmitz, & Doerfler, 1990); health (O'Leary, 1985); and athletic performance (Barling & Abel, 1983). The main topic of this thesis will focus on the relationship between self-efficacy and exercise.

Bandura refined his research on self-efficacy by determining that its roots derive from his proposed social cognitive theory (9). This theory examines the influence of environmental factors surrounding the individual during task performance. The belief includes: "beliefs in one's capability to organize and execute the courses of action required to manage prospective situations" (4). According to Bandura, four sources of self-efficacy exist from his social cognitive theory: mastery experience, vicarious experience, verbal persuasions, and emotional/physiological states (3).

Mastery experience is how an individual evaluates past or present performances as being a success or failure and relates that to the specific task being attempted (2). Mastery experience is the most influential of the four beliefs. Vicarious experience is the effect produced by the actions of others (2). This belief gains more influence when the individual interprets his/her own task as a failure. Verbal persuasion is feedback given by others (2). Positive feedback increases self-efficacy but not to the extent that negative feedback decreases self-efficacy. Physiological states such as anxiety, stress, arousal,

fatigue, and mood states are the direct result of self-efficacy and can often provide insight into an individual's belief of confidence and evaluation of their own performance (2).

In 1991, Bandura and Locke published a meta-analysis stating that efficacy beliefs contribute significantly to the level of motivation and high performance (2). Self-efficacy directly affects an individual's motivation and self-regulatory capabilities. Most people will engage in tasks that they perceive confident in accomplishing and avoid those they feel less confident about. If self-efficacy is low during the task, effort and duration will decrease (2). High self-efficacy will create feelings of confidence in approaching difficult tasks and activities. Low self-efficacy is detrimental to the sense of accomplishment and therefore, leads to lower performance.

The research from Bandura and Locke has allowed for conclusions to be made in all areas of behavior. Recent studies with exercise and self-efficacy have concluded a significant influence on each other (6, 12, 19). Similarities seen in this review involve increased self-efficacy due to mastery experience (in the form of past experiences) and increased self-efficacy due to vicarious experience and verbal persuasion (due to group adherence).

Mastery Experience in Exercise

Mastery experience is the most influential factor on self-efficacy and performance (6). Individuals will base their perception of success on past performances at that specific task. This will lead to individuals performing tasks that perceive they will be able to accomplish, which can hinder beginning an unfamiliar exercise routine. Studies have shown that mastery experience has a direct relationship with exercise adoption (19,

20, 23). Such evidence proves that past and current performance has a direct relationship with exercise efficacy which could perhaps lead to exercise adherence.

Vicarious Experience and Verbal Persuasion in Exercise

Attempting new types of physical activities requires a high amount of confidence. With the ever-growing businesses of health clubs and fitness facilities, certain theories have originated claiming the benefits of adopting an exercise program in a group setting. One theory that supports this claim is vicarious experience in the form of group exercise participation (19). Self-efficacy is a direct result of visualization and modeling which can be influenced by exercising in a group setting. Of all individuals who choose to be physically active, sixty-five percent prefer to participate in group settings (12). Such a percentage allows for fitness facilities to promote themselves as a means for behavior change. However, participants in group exercise often do not adhere to their program past six months; and, at least fifty percent will completely withdraw from an exercise program within the first six months (13). According to a study conducted on group exercise, (12) all exercisers reported high scores of self-efficacy whether or not they actually exercised frequently or not. The reason for high self-efficacy scores was attributed to high amounts of verbal persuasion (12).

Self-efficacy Can Influence Behavior Change

Individuals are responsible for their own behaviors (21). When discussing interventions for behavior change, two theories arise in the literature. They are self-regulation and self-determination theory (8). Both of these theories allow for an

individual to control his or her own fortune and should be highly considered when prescribing exercise.

Self-regulation emphasizes the individual's motivation to adhere to certain tasks (9), which can be achieved by goal setting. Studies have shown that goal-setting is an effective means to increase physical activity participation (3, 5, 27). Goal-setting can help an individual mobilize his or her effort. Influencing this effort can be achieved by interventions that increase self-efficacy.

Self-determination is an individual pursing a goal because of being intrinsically motivated by a certain self implicated reward. In physical activity, personal choice, or autonomy, is motivated by self-determination. According to a study by Thomson and Wankel (43), exercisers perceiving more choice in the physical activities they pursued were more likely to exhibit feelings credited to self-determination. This can be applied to mastery experience in exercise (one of the dimensions of self-efficacy). Individuals will base their choice of physical activity on past performances in order to ensure success and accomplishment. Thus, self determination is a direct result of past exercise efficacy. By implementing an intervention that can increase self-efficacy/self-determination, an individual will adhere to a program of self-regulation.

Overcoming Barriers to Exercise

If self-regulation and self-determination are achieved, people will pursue their goals despite extreme obstacles and barriers. Barriers (obstacles to achieving the chosen task) provide an accurate method of measuring an individual's level of motivation (6). People choose to overcome barriers on a daily basis in order to incorporate physical

activity into their lifestyle. The three most common reported barriers to physical activity are lack of time, lack of energy, and lack of motivation (8). Overcoming the perceived lack of time may be accomplished by improving intrinsic motivation with increasing self-efficacy. Some research even refers to lack of time as a rationalization or excuse for inactivity rather than an actual barrier to exercise (6). Lack of motivation can directly be addressed by improving self-efficacy at the mastery level.

Self-Efficacy and Exercise Adherence

The question of how to motivate the inactive to become active has intrigued fitness experts for decades. Researchers Dishman and Buckworth published a meta-analysis that examined intervention effectiveness in adhering to a consistent exercise program (13). Using mean effect size, the researchers divided interventions into seven categories. Interventions using behavior modification exemplified a greater effect size than any other approach. Another study broadened the seven intervention categories into three categories: informational approaches, behavioral and social approaches, and environmental and policy approaches (20). If these interventions can be customized toward the individual, adherence to regular exercise becomes more probable.

Acute Stretching and Performance

The field of exercise is continually examining the influence pre-exercise stretching has on performance and the prevention of soft-tissue injuries. In 1983 a study conducted on elite soccer players (15), conclusions were drawn that stretching before an activity prevented soft-tissue injuries up to seventy-five percent. However, most current

studies are providing evidence that stretching before exercise is not beneficial (32). Even the American College of Sports Medicine published an article in 2004 finding no benefits for stretching before exercise (29).

The majority of studies that evaluate the acute effects of stretching typically test subjects immediately after the stretch. According to studies conducted by Ian Shrier (28, 29), both force and power decrease immediately after stretching. Shrier makes the point that the decreases in force and power occur with interventions of static and proprioceptive neuromuscular facilitation (PNF) stretching. The percentage of lost force and power varies from each study, but the common range is around 2% to 5% lost (28). Such a difference may seem minimal to the recreational athlete, but among elite competitors, the difference could be the difference between winning a medal or not.

The studies evaluated by Shrier were on acute stretching and its influence on force, torque, and jump. According to Shrier, there were no studies that suggested that stretching is beneficial for these aspects of performance. Acute stretching was divided into static and dynamic stretching. Acute Stretching was found to be detrimental to these areas of performance: force, torque, and jump. Shrier justifies these findings by stating that the muscles' length-tension curve was shifted, meaning that the muscle lost some of its ability to recoil back to a non-contracting state, therefore, losing force and power. These variables were measure by isolating each leg to a different treatment (29). In this context, one must consider that stretching should not be confused with a sport specific warm-up prior to exercise.

Regular Stretching and Performance

Regular stretching can be defined by stretching that is not performed immediately before exercise (29). This type of stretching can occur throughout the day with the possible effect of increasing range of motion (ROM). Studies have shown that the effects of regular stretching are opposite to those of acute stretching. Conclusions have been made that stretching increases both force and power when done regularly for several weeks (18, 29). The improvements range from 3% to 5% in both force and power and can be applied to static and PNF interventions of stretching. There were 7 studies stating that regular stretching improves performance; there were no studies stating that regular stretching decreases performance. However, the studies reviewed only measured short, sprint running; therefore, these failed to address regular stretching and running economy based on increase ROM. Certain data suggests that ROM is not directly affected, but instead the muscles ability to tolerate a stretch (29), meaning that regular stretching may not increase the muscles' ROM. There is also evidence that regular stretching can produce muscle hypertrophy due to certain neurological adaptations by the engaged muscle (26).

Acute Stretching and Injury Risks

Stretching to reduce injury has been recently reviewed by several authors (18, 29, 30) and the common conclusion is that stretching immediately before exercise does not prevent injury; this conclusion can be inferred back to the populations of young, old, and military. Another review of stretching interventions isolated five studies with a total sampling population of 1944 subjects from heterogeneous groups. The authors concluded

with the available data that there is insufficient evidence to suggest stretching exercises are effective in preventing lower limb injuries (33). Such evidence conflicts with interventions initiated by sports coaches and sports medicine professionals.

Acute stretching to prevent injury should not be confused with a sport specific, pre-exercise warm up. Acute stretching prior to exercise can be limited to sport specific movements and should be combined in a dynamic form to mimic the exercise about to be performed, such as a slow jog before a tempo run (28). According to a systematic review of the literature (30), dynamic stretching or ballistic stretching, is now thought to be adequate for warm up due to the fact that dynamic stretching does not lengthen the muscles, allowing for maximum recoil. By evaluating an individual's activity or sport related goals, coaches and professionals will be able to include stretching as an intervention to maximize potential performance along with improving exercise/task efficacy.

Regular Stretching and Injury Risks

Only three studies have isolated the effects of regular stretching on injury prevention and these were completed on the clinical level (1). Regular stretching produced a relevant decrease in injury risk in all three of the studies (1, 28, 29). Justification for this position comes with a variety of theories with the most common one being regular stretching can increase ROM and shorten the time for muscle recovery (15). The majority of studies have focused on acute stretching rather than regular stretching; therefore, other theories must be tested in this specific domain to gain a comprehensive understanding of its use as an intervention for injury risks.

Acute Stretching and Running Economy

As stated earlier, much of the current research concerning acute stretching and performance does not support it as an intervention. The application in which acute stretching has not been widely researched, is in the area of running economy (running efficiency). The small amount of research conducted on acute stretching and running economy does not support the use of stretching to improve performance (29). Explanations for conflicts in this area of research can be attributed to individual differences in body type along with running form (10, 24, 26). For an individual who already has strong running economy, stretching may possibly not provide an increase in performance. The conflict in theories is an area which needs more research conducted on sport specific performance.

Regular Stretching and Running Economy

Only one study has been conducted on the effect of regular stretching on running economy (29). As stated earlier, regular stretching can increase force and power therefore increasing performance. The most evident difference in regular stretching as an intervention to improve running economy is due to the variable of ROM. Clinical evidence states that running economy is unchanged with regular stretching because muscle stiffness does not change even with increased ROM (28, 29). The only seen benefit would be increasing the running economy of sprinters because so much is dependent on force and power. An improvement of .06 seconds in a 50 yard sprint was the result of a heterogeneous study conducted by Shrier (29). Such a claim needs to be

narrowed to a more elite, homogeneous sampling population where indicated differences in performance are much less. Regular stretching and running economy lacks an abundance of research leading to lack of inferences.

State Anxiety and Exercise

According to a study conducted on state anxiety (48), benefits of physical activity on anxiety include reduced anxiety with individuals engaged in aerobic exercise, reduced anxiety with individuals who regularly exercise (regular as defined by ACSM, 40), reduced anxiety with individuals who have lower initial fitness levels, and reduced anxiety with individuals who have high initial state anxiety. Psychologists Lazarus and Cohen (49) associate anxiety with worry, self-doubt, and apprehension arising "in the face of demands that tax or exceed the resources of the system" (49). For this study, the "demands" that "tax" the system can be considered exercise. Six meta-analyses conducted between 1960 and 1995 reported a small to moderate correlation that acute and chronic exercises reduce anxiety levels (50-55). According to the previously mention study (Ref), the reduction in anxiety can be inferred to all samples from the population regardless of exercise intensity, duration, or the type of exercise. One trend found in all articles on state anxiety and exercise indicates that individuals with a low level of anxiety previous to exercise experience a lessoned reduction in anxiety post-exercise. A reduction in state anxiety could possibly lead to an increase in exercise adherence (53).

Stretching as an Affective Intervention

This review was conducted to explore potential influences that acute stretching before exercise has on self-efficacy and state anxiety. The research on self-efficacy proves that implementing the correct intervention can increase an individual's confidence toward their involvement in physical activity. By manipulating variables in the four dimensions of self-efficacy identified by Bandura (mastery experience, vicarious experience, verbal persuasions, and physiological states) fitness professionals would be able to incorporate activity that individuals would be more likely to accomplish. Increasing the exercise experience incorporating these four dimensions could possibly allow for the potential of exercise adherence.

Acute stretching has been abandoned as an intervention for increased performance (30). Neglecting stretching previous to exercise may possibly eliminate affective adaptations one would make before attempting physical activity. If acute stretching could increase self-efficacy, individuals could see its use in various areas of sport performance at any level. By implementing acute stretching as an intervention for increased self-efficacy, the individual may experience an increase in performance, then an increase in mastery level efficacy, then more potential for exercise adherence. Regular stretching could also be used as an intervention influencing self-efficacy and state anxiety levels. Additional research needs to be conducted to prove if these interventions for affective adaptation are statistically significant.

Fitness experts understand the influence and relationship the affective and physiological domains play in all areas of exercise. By identifying ways to make the psychosomatic connection, one could theorize that positive adaptations would occur.

Using stretching as an intervention to increase the psychosomatic relationship is just one small improvement experts could make when implementing physical activity programs and eliminating barriers to exercise. Increasing self-efficacy and decreasing state anxiety may eliminate barriers to exercise, thus making the positive behavior change more of a reality.

# CHAPTER III

# METHODOLOGY

## Introduction

The purpose of this study was to examine the influence of stretching prior to exercise on self-efficacy and state anxiety. This chapter details the methodology utilized in the completion of the study. Prior to the recruitment of subjects, this methodology was approved by the Institutional Review Board at Oklahoma State University.

Chapter III is divided into three categories: preliminary procedures, operational procedures, and follow-up procedures. The preliminary procedures are further divided into the following subcategories: selection of subjects, selection of instruments, selection of sites, selection of cycling time trial equipment, and selection of literature for control intervention. The operational procedures are further divided into the following subcategories: preliminary procedures, operational procedures, data collection trial for the, data collection trial for the control intervention, and statistical analysis.

## Preliminary Procedures

### Selection of Subjects

Male and female subjects between the ages of 18 and 24 years were recruited using the Experimetrix Research Subject Pool at Oklahoma State University. The

researcher listed a description of the experiment, contact information, and available time slots on the Experimetrix website.

To be eligible for participation in the study, subjects were required to be moderately active and a non-smoker. To be considered moderately active, subjects had to engage in some type of physical activity at least three hours per week. Furthermore, the activities in which the individuals participated had to be of at least moderate intensity, which is equivalent to walking 3 to 4 miles per hour for many individuals (40). These parameters were put into place to help ensure that the subjects possessed a level of physical fitness sufficient to successfully and safely complete the two sessions of cycling time trial and the accompanying warm-up and cool-down.

Initially, 23 subjects signed up to participate in the study, 13 males and 10 females. Because the study involved two separate experimental times, 7 of these subjects, 4 males and 3 females, only participated in one trial of the experiment. The remaining 16 volunteers, 10 male and 6 female, were randomly assigned to either a stretching or non-stretching group which determined which trial they would be completing first. All 16 of the volunteers completed both the stretching and non-stretching experimental trials. By randomly assigning which trial the subject would complete first, certain threats to internal validity were prevented such as subject bias.

A total of 16 subjects, 10 male and 6 female, completed the both trials of the study. This final sample included 8 subjects completing the stretching trial first and 8 subjects completing the non-stretching trial first. Because the subjects used the Experimetrix Research Subject Pool, they may have received compensation through a credit/grade for a currently enrolled class.

**Selection of Instruments**

The following instruments were included in the present study:

1. Acute Exercise Self-Efficacy Questionnaire—This questionnaire is designed to measure confidence levels which are associated with levels of self-efficacy right before exercise. It was adapted from a similar questionnaire developed by McAuley which measured levels of self-efficacy prior to physical activity (56). The instrument contains 8 questions with a range from 0% (non confident at all) in increments of 10% up to 100% (highly confident). The percentages are prompted by a question about how long the subject will be able to ride on the cycling protocol. The first questions ask about 2 minutes of the cycling protocol while the last question asks about 16 minutes of the cycling protocol. The increments for each question are 2 minutes. By identifying confidence levels prior to exercise, certain inferences towards acute self-efficacy can be made about the subject.

2. The Physical Activity Readiness Questionnaire (PAR-Q)—This questionnaire is designed to identify individuals who have contraindications to moderate-intensity physical activity and who should seek medical clearance from a physician before beginning physical activity. The PAR-Q is regarded as "valid, cost-effective, and time-efficient" (40). The researcher chose to exclude any subject who answered "yes" to any question on the PAR-Q. No exclusions were necessary because all

subjects answered “no” to each question on the PAR-Q. The PAR-Q is shown in Appendix B.

3. State-Trait Anxiety Inventory (STAI) 10 Question State Inventory—This particular survey is designed to measure state anxiety. The State Anxiety scale is used to assess how anxious a person feels at that moment. while Each scale contains 10 statements, and individuals completing the STAI are asked to indicate how well each statement relates to them on a scale of 1 to 4, with 1 being “not at all” and 4 being “very much so” (38). The test/retest validity of the 28 item original STAI has been proven at a .73-.86 rate (38, 39). The validity of the full scale STAI based on internal consistency coefficients is at a .89-.92 rate (39).

**Selection of Testing Site**

Each of the two experimental trials was conducted in the university exercise physiology lab with the cycling testing equipment. To provide a non-threatening environment, tables and chairs were provide for the subjects to use while answering the questionnaires.

**Selection of Testing Equipment and Supplies**

Among the equipment and supplies used for the cycling time trial were Monark stationary bikes and Polar heart rate monitors. The stationary bikes were Monark Cardio Care 827E cycle ergometers. Each one provided a timer, cadence display (RPM), and heart rate display (BPM). The strap used for the heart rate display was a Polar Heart Rate

Monitor strap. Subjects were not allowed to exceed their calculated maximum heart rate of the subjects' age subtracted from 220.

### Selection of Intervention for Non-Stretching Trial

The selection for which intervention was to be completed first was randomized. Half of the subjects (8) completed the non-stretching intervention first. The non-stretching trial consisted of reading a book on cycling for 5 minutes, then answering the questionnaires followed by the cycling time trial. The book read during the non-stretching trial was *Lance Armstrong: Images of a Champion* (Armstrong, 2004) with over 200 pages. The subject was instructed to freely peruse the book in no particular order for 5 minutes which is the equal duration the stretching would take in the other trial.

## Operational Procedures

### Data Collection Trial for the Stretching Intervention

The Experimetrix system informed potential subjects of meeting time and room number. The Experimetrix system also informed potential subjects on expectations and time constraints for the trials. It was suggested that they must sign up for two time slots at least 48 hours apart. Only one subject was tested at a time. Once potential subjects reported to the exercise physiology lab, they were instructed to answer questions on the PAR-Q and the researcher determined if they were physically ready to complete both trials. It should be noted that no potential subjects were turned away because of the PAR-Q. Following approval from the researcher, subjects were briefed on what the

experiment would entail. The subject was then instructed on which trial they would be completing first depending on their own random assignment. Subjects completing the stretching intervention trial first were instructed to put on the Polar Heart Rate Monitor strap. Then, the subjects were lead through a series of 3 static stretches. The static stretches included two sets of for each muscle group holding 20 seconds each. The stretches were completed in this order: right and left quadriceps, right and left hamstring, and right and left gluteus maximus. Following the stretches, subjects were asked to complete the STAI and Acute Self-Efficacy Questionnaire. At the top of the questionnaires, subjects were asked to write their initials next to their pre-assigned subject number, circle "M" or "F" to indicate gender, and his/her age. The same subject number was used on the second experimental trial. It took approximately 5 to 10 minutes to complete both questionnaires.

Once both questionnaires were complete, the subjects were sized on the cycling ergometer for the correct seat and handlebar height. Handlebar height is subjective and various depending on subject preference. Seat height was determined by obtaining an angle of 20 degrees on the posterior (popliteal region) of the knee when the foot and pedal was at the 3 o'clock position. Subjects then pedaled at a resistance of 0.5 kg for 3 minutes for warm-up. During this time the researcher informed the subject on how the cycling protocol was to be conducted. The cycling protocol consisted of an increase of resistance of 1 kg every 3 minutes while pedaling at 50-55 RPMs. The maximum amount of time the subject could possibly complete was 21 minutes finishing the last three minutes at 7 kg of resistance. No subjects completed the entire stage protocol. During warm-up subjects were informed that this was not a maximal test and

that they need to cycle as long as they could before the resistance became too difficult or the RPMs fell under 50. Once either one of these conditions were met, the researcher reduced the pedaling resistance to 0.5 kg and instructed to subject to pedal until their HR fell between 30-40% of their maximum HR (this typically took 3-6 minutes of cool-down). This constituted the cool-down. Following the cool down, subjects were asked to complete another STAI questionnaire.

**Table 1—Outline of Activity for Stretching Intervention Trial**

| | |
|---|---|
| Minutes 1-2 | Inform subject about experiment |
| Minutes 2-4 | Complete and evaluate PAR-Q |
| Minutes 4-6 | Static stretching quads |
| Minutes 6-8 | Static stretching hamstrings |
| Minutes 8-10 | Static stretching glutes |
| Minutes 10-15 | Complete questionnaires |
| Minutes 15-17 | Subject sized to bike |
| Minutes 17-20 | Warm-up at 0.5 kg resistance |
| Minute 20 | Begin staged time trial |
| Minutes 20-23 | Time trial at 1 kg resistance |
| Minutes 23-26 | Time trial at 2 kg resistance |
| Minutes 26-29 | Time trial at 3 kg resistance |
| Minutes 29-32 | Time trial at 4 kg resistance |
| Minutes 32-35 | Time trial at 5 kg resistance |
| Minutes 35-38 | Time trial at 6 kg resistance |
| Minutes 38-41 | Time trial at 7 kg resistance |
| Minutes 41-45 | Cool down at 0.5 kg resistance |
| Minutes 45-55 | Complete questionnaires |

**Data Collection Trial for the Non-Stretching Intervention**

The Experimetrix system informed potential subjects of meeting time and room number. The Experimetrix system also informed potential subjects on expectations and

time constraints for the trials. It was suggested that they must sign up for two time slots at least 48 hours apart. Only one subject was tested at a time. Once potential subjects reported to the exercise physiology lab, they were instructed to answer questions on the PAR-Q and the researcher determined if they were physically ready to complete both trials. It should be noted that no potential subjects were turned away because of the PAR-Q. Following approval from the researcher, subjects were briefed on what the experiment would entail. The subject was then instructed on which trial they would be completing first depending on their random assignment. Subjects completing the non-stretching intervention trial first were instructed to put on the Polar Heart Rate Monitor strap. Then, the subjects were instructed to read and look through the book *Lance Armstrong: Images of a Champion* (Armstrong, 2004) for 5 minutes in no particular order. Following the book, subjects were asked to complete the STAI and Acute Self-Efficacy Questionnaire. At the top of the questionnaires, subjects were asked to write their initials next to their pre-assigned subject number, circle "M" or "F" to indicate gender, and their age. The same subject number was used on the second experimental trial. It took approximately 5 to 10 minutes to complete both questionnaires.

Once both questionnaires were complete, the subjects were sized on the cycling ergometer for the correct seat and handlebar height. Subjects then pedaled at a resistance of 0.5 kg for 3 minutes for warm-up. During this time the researcher informed the subject on how the cycling protocol was to be conducted. The cycling protocol consisted of an increase of resistance of 1 kg every 3 minutes while pedaling at 50-55 RPMs. The maximum amount of time the subject could possibly complete was 21 minutes finished the last three minutes at 7 kg of resistance. Each subject completed a different time

depending on effort. No subjects completed the entire stage protocol. During warm-up subjects were informed that this was not a maximal test and that they need to cycle as long as they could before the resistance became too difficult or the RPMs fell under 50. Once either one of these conditions were met, the researcher reduce the pedaling resistance to 0.5 kg and instructed to subject to pedal until their HR fell between 30-40% of their maximum HR (this typically took 3-6 minutes of cool-down). This constituted as the cool-down. Following the cool down, subjects were asked to complete another STAI questionnaire.

**Table 2—Outline of Activity for Non-Stretching Intervention Trial**

| | |
|---|---|
| Minutes 1-2 | Inform subject about experiment |
| Minutes 2-4 | Complete and evaluate PAR-Q |
| Minutes 5-10 | Read and look at book |
| Minutes 10-15 | Complete questionnaires |
| Minutes 15-17 | Subject sized to bike |
| Minutes 17-20 | Warm-up at 0.5 kg resistance |
| Minute 20 | Begin staged time trial |
| Minutes 20-23 | Time trial at 1 kg resistance |
| Minutes 23-26 | Time trial at 2 kg resistance |
| Minutes 26-29 | Time trial at 3 kg resistance |
| Minutes 29-32 | Time trial at 4 kg resistance |
| Minutes 32-35 | Time trial at 5 kg resistance |
| Minutes 35-38 | Time trial at 6 kg resistance |
| Minutes 38-41 | Time trial at 7 kg resistance |
| Minutes 41-45 | Cool down at 0.5 kg resistance |
| Minutes 45-55 | Complete questionnaires |

**Statistical Analysis**

All statistical analyses were completed using the SPSS 12.0 version for Windows. In order to analyze in between subject effect differences, a general linear model 2x2 doubly-repeated measures ANOVA was produced using the total score for each of the data collection points. State anxiety scores were totaled by reverse coding 5 items; this total was analyzed by within subject effect differences. The subjects' final scores were then compared for within subject effect differences. The 8 items Acute Self-Efficacy questionnaire was scored by adding all 8 items dividing to get a mean score, and then analyzed using a paired samples t-test. The final gain scores were compared for within subject effect differences using a 0.05 level of significance.

## Follow-Up Procedures

Subjects were assigned credit through Experimetrix once both trials were complete. During the second trial, subjects were informed that once the results of the study were complete, they may view the anonymous results.

# CHAPTER IV

# RESULTS AND DISCUSSION

## Introduction

This study was designed to examine the influence of pre-exercise stretching on exercise self-efficacy and state anxiety. Oklahoma State University students were recruited and subsequently assigned to complete a stretching trial and a non-stretching trial depending on randomization. The stretching trial consisted of completing a series of three static stretches before beginning the cycling time trial. The non-stretching trial consisted of perusing through a book before beginning the cycling time trial. Before completing the first trial, potential subjects were evaluated through the PAR-Q fitness questionnaire. Once deemed fit to participate in the study, subjects completed one of the two trials then reported for the second trial at least 48 hours from the first. The data collection consisted of the subject completed two questionnaires, STAI (State-Trait Anxiety Inventory) and Acute Exercise SE (Self-Efficacy), between the intervention and the cycling time trial. Following the time trial, the subject was asked again to complete the STAI questionnaire.

## Hypotheses

Two null hypotheses were tested. One was tested to determine if there were any significant differences between the stretching and non-stretching intervention on state anxiety using the 10 item STAI. The other hypothesis was tested to determine if there were any significant differences between the stretching and non-stretching intervention on acute exercise self-efficacy using the 8 item Acute Self-Efficacy questionnaire. Effects of condition and time were also compared using the same analysis. Each null hypothesis was tested at the 0.05 significance level using 2x2 doubly-repeated measures ANOVA.

## Results

Type III sum of squares, degrees of freedom, mean square, F-values, and p-values are displayed in Table 3 on the following pages. Using a general linear model ANOVA, each group of within subject scores was compared to each other using a 0.05 significance level. Descriptive statistics for the workload during the cycling protocol are: mean time to exhaustion (9.702 minutes), mean for ending Borg's RPE (18.9 rate of perceived exertion), and mean maximum exertional heart rate (175.3 beats per minute).

**Table 3--Test of Within Subjects Effects—STAI Scores**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| condition* | 0.063 | 1 | 0.063 | 0.006 | 0.941 |
| error (condition) | 162.937 | 15 | 10.862 | | |
| Time** | 189.062 | 1 | 189.062 | 13.508 | 0.002 |
| error (time) | 209.937 | 15 | 13.996 | | |
| condition and time | 2.25 | 1 | 2.25 | 0.289 | 0.599 |
| error (cond. & time) | 116.75 | 15 | 7.783 | | |

* "condition" refers to the stretching and non-stretching intervention
** "time refers to the interaction between pre-and post- tests

| Table 4--Means of Anxiety Within Performance | | | |
|---|---|---|---|
| | **Pretest** | **Posttest** | |
| **Stretching Condition** | 15.5 | 19.3 | 17.4* |
| **Non-Stretching Condition** | 15.8 | 18.9 | 17.3* |
| | 15.656** | 19.094** | |

* represent marginal means of Pretest and Posttest within condition
**represent marginal means of Pretest and Posttest within Time only

| Table 5--Paired Samples t-Test (2-tailed)--Self-Efficacy Scores | | | | |
|---|---|---|---|---|
| | **Mean** | **Std. Deviation** | **t** | **Sig.** |
| Stretching Intervention | 75.53 | 20.97 | | |
| Control Intervention | 69.19 | 20.14 | | |
| Paired t-test | | | 1.02 | 0.323 |

## Interaction Effects

According to Table 4, the marginal means reported for the treatment interaction of the stretching and non-stretching condition [17.4 = 17.3] are not statistically significant. However, the marginal means reported for the treatment interaction of time between pre- and post- test administration proved to be statistically significant [15.656 ≠ 19.094].

## Differences in State Anxiety

According to Table 3 and 4, there were no significant differences between the condition of stretching and non-stretching interventions within the subjects [F (1, 15) = .006; .05<.0941].

## Differences in Acute Self-Efficacy

According to Table 5, there were no significant differences between the condition of stretching and non-stretching interventions within the subjects [t = 1.02; p = .323].

**Influence of Time**

According to Table 3 and 4, there were significant differences between the condition of stretching and non-stretching interventions within the time of the test (pre and post test) for state-anxiety [$F (1, 15) = 13.508$; $p<.002$].

**Results of Hypothesis Testing**

$H_o1$: There will be no significant differences in the subjects' STAI scores between the experimental and control session. $H_o1$ was failed to reject.

$H_o2$: There will be no significant differences in the subjects' Acute Self-Efficacy Questionnaire scores between the experimental and control session. $H_o2$ was failed to reject.

## Discussion of Results

This study compared the affective state responses to pre-exercise stretching, and a non-stretching control.

**Non-Differences Between Groups**

As noted in the results section, there were no differences on scores between groups on the STAI and/or the Acute Self-Efficacy questionnaires. The researcher speculates that the lack of differences may be due to by using an adaptive (shortened) version of these two questionnaires. Due to time constraints by the Experimetrix Subject Pool, only one hour could be used per data collection session. The researcher modified

each assessment by decreasing the length of each of the two questionnaires to facilitate the one hour time slot. It should also be noted that only one researcher collected data, which resulted in less time slots for subjects to fill. The small number of time slots then resulted in a low sample size of 23 subjects in which only 16 completed both trials. Therefore, small sample size could possibly have contributed to no differences between groups.

**Influence of Time**

As noted in the results section, the only difference between subject groups was the influence of time. The researcher speculates that this difference could possibly be due to the modified 10 item STAI questionnaire. The full version of the STAI is a 28 item inventory measuring state and trait anxiety. Due to time constraints, the researcher was only interested in state anxiety and therefore modified the 28 item scale into a 10 item scale measuring only state anxiety. The researcher also speculates that the influence of time could be accounted for by increased energy levels following a close to maximal cycling time trial. A larger sample size would perhaps allow for a more detailed analysis on the influence of time.

**Subject Expectations**

As noted earlier subjects were randomly assigned to complete either the stretching or non-stretching intervention as their first experimental trial. An equal number of subjects were assigned to this order prior to experimentation. Because each experimental trial was the same with the exception of the intervention, the researcher speculates that

the subjects were able to adjust their answers to the questionnaires on their second trial based on their experience with the initial trial. Subjects' scores could possibly have been influenced by their expectations of the second trial which would result in lower Acute Self-Efficacy scores.

## Implications

Even though the average life expectancy increases annually, the quality of life for individuals may not increase. Professionals in health and exercise, including psychologists, exercise physiologists, personal trainers, and physicians, are constantly interacting with individuals who could benefit greatly from a heightened quality of life. Physical activity can provide a medium to improve one's quality of life without prescription drugs. Providing methods to increase self-efficacy and decrease anxiety during exercise could possibly be the best next step for improving our society's overall quality of life.

The results of the present study could provide possible insight into new methods to overcome barriers to physical activity. Pre-exercise stretching is not the only intervention that can be manipulated to increase the affective response to physical activity. Other variables could be hypothesized and tested that might increase an affective response to exercise. Even though the present study found no importance in using pre-exercise stretching as a way to improve exercise adherence, it explored an affective variable that may provide future research opportunities.

# CHAPTER V

# SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

## Introduction

Chapter V first summarizes the purpose and methodology of the present study. Next, the findings of the study are briefly discussed in relation to the null hypotheses. The conclusions that have been drawn based on the results of this study are then discussed. Finally, the chapter is concluded with recommendations for future research.

## Summary of Purpose and Methodology

Recently arguments have been made against incorporating stretching as part of the warm-up before an acute bout of exercise. Research has been conducted exploring the physical benefits of pre-exercise stretching and regular/routine stretching. Less research has been conducted on the affective benefits of pre-exercise stretching before an acute bout of exercise. If pre-exercise stretching provides little or no benefit in physical performance, then can it increase self-efficacy which in turn increases exercise adherence? Specifically, what affects does stretching before a bout of exercise have on

self-efficacy and state anxiety levels? The purpose of the present study was to explore and evaluate this latter question. It was the goal of the researcher to 1.) identify a way to increase exercise self-efficacy and 2.) identify another strategy to decrease an individual's state anxiety level prior to exercise.

Male and female subjects between the ages of 18 and 24 years were recruited using the Experimetrix Research Subject Pool at Oklahoma State University. To be eligible for participation in the study, subjects were required to be moderately active and a non-smoker. Initially, 23 subjects signed up to participate in the study, 13 males and 10 females. Because the study involved two separate experimental times, 7 of these subjects, 4 males and 3 females, only participated in one trial of the experiment. The remaining 16 volunteers, 10 male and 6 female, were randomly assigned to either a stretching or non-stretching group which determined which trial they would be completing first. All 16 of the volunteers completed both the stretching and non-stretching experimental trials.

During the pre-stretching trial, the subjects were lead through a series of 3 static stretches. The subjects then answered completed both an STAI and an Acute Self-Efficacy questionnaire. Subjects then completed the cycling time trail based on their own perceived efforts. Following a cool-down, each subject then completed another STAI to measure anxiety following exercise. The non-stretching intervention was the exact same trial except subjects read a book on cycling before completing the time trial to serve as the control intervention.

## Summary of Findings

The following two null hypotheses were tested at the 0.05 level of significance:

$H_o1$: There will be no significant differences in the subjects' STAI scores between the experimental and control session. $H_o1$ was failed to reject.

$H_o2$: There will be no significant differences in the subjects' Acute Self-Efficacy Questionnaire scores between the experimental and control session. $H_o2$ was failed to reject.

## Conclusions

Within the limitations of this study, the following conclusions were reached:

1. Pre-exercise stretching does not significantly influence state anxiety.
2. Pre-exercise stretching does not significantly influence acute self-efficacy.

## Recommendations for Future Research

1. Similar studies need to be conducted using a larger sample size and using the 28 item STAI questionnaire.
2. A longitudinal study needs to be conducted analyzing the influence of stretching as a part of a warm up for physical activity on exercise adherence.

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# APPENDIX A

# PHYSICAL ACTIVITY READINESS QUESTIONNAIRE

**Physical Activity Readiness Questionnaire (PAR-Q)**

American College of Sports Medicine. (2000). *ACSM guidelines for testing and exercise prescription* (6th ed.). Baltimore, MD: Lippincott, Williams, & Wilkins.

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. Since you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

| Yes | No | |
|---|---|---|
| ☐ | ☐ | 1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor? |
| ☐ | ☐ | 2. Do you feel pain in your chest when you do physical activity? |
| ☐ | ☐ | 3. In the past month, have you had chest pain when you were not doing physical activity? |
| ☐ | ☐ | 4. Do you lose your balance because of dizziness or do you ever lose consciousness? |
| ☐ | ☐ | 5. Do you have a bone or joint problem that could be made worse by a change in your physical activity? |
| ☐ | ☐ | 6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition? |
| ☐ | ☐ | 7. Do you know of any other reason why you should not do physical activity? |

## If you answered YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want—as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

## If you answered NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active—begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal—this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever—wait until you feel better; or
- if you are or may become pregnant—talk to your doctor before you start becoming more active.

**Please note:** If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction.

**Name:** _____

**Signature:** _____ **Date:** _____

**Witness:** _____

## APPENDIX B

## State Trait Anxiety Inventory

**Self-Evaluation Questionnaire (STAI)**

A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you feel right now, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

| | Not at all | Somewhat | Moderately | Very much so |
|---|---|---|---|---|
| 1. I feel calm | O | O | O | O |
| 2. I am tense | O | O | O | O |
| 3. I feel frightened | O | O | O | O |
| 4. I feel nervous | O | O | O | O |
| 5. I am relaxed | O | O | O | O |
| 6. I am worried | O | O | O | O |
| 7. I feel at ease | O | O | O | O |
| 8. I am jittery | O | O | O | O |
| 9. I feel steady | O | O | O | O |
| 10. I am presently worrying about possible misfortunes | O | O | O | O |

## APPENDIX C

## Acute Self-Efficacy Questionnaire

The items listed below are designed to assess your beliefs in your ability to continue the cycling trial protocol. Using the scale listed below, please indicate how confident you are that you will be able to continue the cycling protocol.

For example, if you have complete confidence that you will be able to complete 4 minutes of the protocol without stopping, you would circle 100%. However, if you had no confidence at all that you could complete 4 minutes of the protocol without stopping, you would circle 0%.

Please remember to answer honestly and accurately. There are no right or wrong answers.

## Mark your answer by circling a %.

1. I am able to continue the cycling protocol for 2 minutes.

| 0% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
|---|---|---|---|---|---|---|---|---|---|---|
| NOT AT ALL CONFIDENT | | | | | MODERATELY CONFIDENT | | | | | HIGHLY CONFIDENT |

2. I am able to continue the cycling protocol for 4 minutes.

| 0% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
|---|---|---|---|---|---|---|---|---|---|---|
| NOT AT ALL CONFIDENT | | | | | MODERATELY CONFIDENT | | | | | HIGHLY CONFIDENT |

3. I am able to continue the cycling protocol for 6 minutes.

| 0% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
|---|---|---|---|---|---|---|---|---|---|---|
| NOT AT ALL CONFIDENT | | | | | MODERATELY CONFIDENT | | | | | HIGHLY CONFIDENT |

4. I am able to continue the cycling protocol for 8 minutes.

| 0% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
|---|---|---|---|---|---|---|---|---|---|---|
| NOT AT ALL CONFIDENT | | | | | MODERATELY CONFIDENT | | | | | HIGHLY CONFIDENT |

5. I am able to continue the cycling protocol for 10 minutes.

| 0% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
|---|---|---|---|---|---|---|---|---|---|---|
| NOT AT ALL CONFIDENT | | | | | MODERATELY CONFIDENT | | | | | HIGHLY CONFIDENT |

6. I am able to continue the cycling protocol for 12 minutes.

| 0% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
|---|---|---|---|---|---|---|---|---|---|---|
| NOT AT ALL CONFIDENT | | | | | MODERATELY CONFIDENT | | | | | HIGHLY CONFIDENT |

7. I am able to continue the cycling protocol for 14 minutes.

| 0% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
|---|---|---|---|---|---|---|---|---|---|---|
| NOT AT ALL CONFIDENT | | | | | MODERATELY CONFIDENT | | | | | HIGHLY CONFIDENT |

8. I am able to continue the cycling protocol for 16 minutes.

| 0% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
|---|---|---|---|---|---|---|---|---|---|---|
| NOT AT ALL CONFIDENT | | | | | MODERATELY CONFIDENT | | | | | HIGHLY CONFIDENT |

## APPENDIX D

## INFORMED CONSENT FORM

**CONSENT TO PARTICIPATE IN A RESEARCH STUDY**
**OKLAHOMA STATE UNIVERSITY**
**Use for Experimetrix Recruitment**

**PROJECT TITLE**: The Effects of Pre-Exercise Stretching: Affective and Physiological

**INVESTIGATORS**: Bridget Miller, Ph.D.:, William Davis Hale B.S

**PURPOSE**:

This study, which is research conducted for a student honor thesis and independent study, is being conducted through Oklahoma State University. The purpose is to explain correlation (a relationship), if any, exists between pre-exercise stretching and certain affective and physiological aspects of exercise (effects on the mind and body). Results would yield benefits to an area of the active population.

**PROCEDURES**:

The project will involve the completion of four questionnaires along with a 15 minute cycling time trial. The first questionnaire will ask for information regarding your self-efficacy (motivation) toward the exercise you are about to complete. . The second questionnaire will ask subject's mood state before and after the exercise. The third questionnaire will evaluate subject's self-efficacy before exercise. The fourth questionnaire will measure task mastery (success on the exercise) on how you feel you performed during this time trial.

The study is designed to last two sessions of 45-60 minutes.

**RISKS OF PARTICIPATION**:

There are no risks associated with this project, including stress, psychological, social, physical, or legal risk, which are greater, considering probability and magnitude than those ordinarily encounter in your 3 hour a week moderate physical activity. If, however, you begin to experience discomfort or stress in this project, you may end you participation at any time.

**BENEFITS OF PARTICIPATION:**

You may gain an appreciation and understanding of how research is conducted. You may also realize certain physical and psychological attributes that you possess.

**CONFIDENTIALITY**:

All Information about you will be kept confidential and will not be released. Questionnaires and record forms will have identification numbers, rather than names, on them. All information will be kept in a file cabinet that is accessible only to the researcher and his supervisor. This information will be saved only as long as need for statistics to be run. Results from this study may be presented at professional meetings or in publications without any reference to your personal identification. You will not be identified individually; we will be evaluating the group as a whole.

Confidentiality will be maintained except under specified conditions required by law. If human lives are at stake, confidentiality can be broken. Confidentiality could be broken if materials from this study were subpoenaed by a court of law.

**COMPENSATION**:

Compensation will only be given through the experimetrix research system.

**CONTACTS**:

I understand that I may contact any of the researchers at the following addresses and phone numbers, should I desire to discuss my participation in the study and/or request information about the results of the study: Bridget Miller, Ph.D., Colvin Recreation Center, Dept. of Health and Human Performance Oklahoma State University, Stillwater, OK 74078, (405) 744-7680. I may also contact Sue Jacobs, Ph.D., Institutional Review Board, 415 Whitehurst, Oklahoma State University, Stillwater, OK 74078, (405) 744-1676 with any questions concerning participant's rights.

**PARTICIPANT RIGHTS**:

I understand that my participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time, without penalty.

**CONSENT DOCUMENTATION**:
I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and the benefits of my participation. I also understand the following statements:

I affirm that I am 18 years of age or older, a non-smoker, and currently moderately active at least 3 hours per week.

I understand the risks associated with this study and voluntarily choose to participate. I understand that in case of illness or injury resulting from this study, emergency medical treatment will be available through Stillwater EMS. I understand that no funds have been set aside by Oklahoma State University to compensate me in the event of illness or injury.

I have read and fully understand this consent form. I sign it freely and voluntarily. I copy of this form will be given to me. I hereby give permission for my participation in the study.

---

Signature of Participant Date

I certify that I have personally explained this document before requesting that the participant sign it.

---

Signature of Researcher Date

## APPENDIX F

## SUBJECT INFORMATION SHEET

**Subject Information Sheet**

**Name: _____**

**Age: _____**

**Active Email Address: _____**

**On average, how many days per week do you currently engage in physical activity?—(please circle one)**

**0 1 2 3 4 5 6 7**

**On average, how long do you currently engage in physical activity at a time?—**

**(please circle one)**

**Less than 30 minutes 30 minutes More than 30 minutes**

**Do you typically engage in moderate-intensity physical activity or greater? For many people, moderate intensity physical activity would be equivalent to walking 3 to 4 miles per hour.—(please circle one)**

**Yes** **No**

**Do you smoke more than 1 cigarette per week?—(please circle one)**

**Yes** **No**

## APPENDIX G

## Data Collection Form

Name Age ID#

| Stage(3 min) | HR | Borg's RPE | Total Time |
|---|---|---|---|
| 1 kg 50 RPM | | | |
| | | | |
| | | | |
| 2 kg 50 RPM | | | |
| | | | |
| | | | |
| 3 kg 50 RPM | | | |
| | | | |
| | | | |
| 4 kg 50 RPM | | | |
| | | | |
| | | | |
| 5 kg 50 RPM | | | |
| | | | |
| | | | |
| 6 kg 50 RPM | | | |
| | | | |
| | | | |
| 7 kg 50 RPM | | | |
| | | | |
| | | | |

| Testing Group: | Stretching | Non-Stretching |
|---|---|---|

**Date**:

**Other Comments:**

## APPENDIX H

## IRB Approval Letter

## Oklahoma State University Institutional Review Board

Date: Thursday, August 25, 2005

IRB Application No ED065

Proposal Title: The Benefits of Pre-Exercise Stretching: Affective and Physiological

Reviewed and Processed as: Expedited

**Status Recommended by Reviewer(s): Approved Protocol Expires: 8/24/2006**

Principal Investigator(s

William Hale
5207 N. Husband
Stillwater, OK 74075

Bridget Miller
187 Colvin Center
Stillwater, OK 74078

---

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☑ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 415 Whitehurst (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,

Sue C Jacobs

Sue C. Jacobs, Chair
Institutional Review Board

VITA

William Davis Hale

Candidate for the Degree of

Master of Science

Thesis: AFFECTIVE STATE RESPONSE TO STRETCHING BEFORE AN ACUTE BOUT OF EXERCISE

Major Field: Health and Human Performance

Biographical:

Personal Data: Born in Sonora, Texas on September 23, 1977, the son of Mike and Rita Hale.

Education: Graduated from Sonora High School, Sonora, Texas, in May 1996; received Bachelor of Science degree in Kinesiology with a minor in Language Arts from Angelo State University, San Angelo, Texas in May 2001; will have completed requirements for the Master of Science degree in Health and Human Performance at Oklahoma State University, Stillwater, Oklahoma in July, 2006.

Experience: Language Arts Instructor, New Braunfels, Texas (2001-2004); Assistant Football and Track Coach, New Braunfels, Texas (2001-2004); Graduate Teaching Assistant in Total Wellness (2004-present); Graduate Teaching Assistant in Pedagogy of Fit and Well, Sports Skills, Elementary PE, and Outdoor Education (2004-2005).

Professional Memberships: American College of Sports Medicine, United States Triathlon Association, Nation Off-Road Bicycle Association

Name: William Davis Hale Date of Degree: July, 2006

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: AFFECTIVE STATE RESPONSE TO STRETCHING BEFORE AN ACUTE BOUT OF EXERCISE

Pages in Study: 69 Candidate for the Degree of Master of Science

Major Field: Health and Human Performance

Scope and Method of Study: Sixteen University Students (8 male, 8 female) volunteered for this study which purpose was determine the influence of stretching before exercise on affective states such as state anxiety and acute self-efficacy. Participants completed two experimental trials which included a maximal effort cycling time trial. Each subject completed sessions, one with a stretching intervention and one with a control intervention. Subjects completed an STAI questionnaire to measure state anxiety during pre- and post- the cycling time trial on both experimental sessions. An Acute Self-Efficacy questionnaire was also administered before the cycling time trial in both experimental sessions.

Findings and Conclusions: Within subjects differences were analyzed using a general linear model ANOVA and a paired samples t-test. There was no influence of pre-exercise stretching on state anxiety and acute self-efficacy. Therefore, acute stretching before a bout of exercise does not influence self-efficacy and/or state anxiety.

ADVISER'S APPROVAL: Steve Edwards, Ph.D