EFFECTS OF AEROBIC EXERCISE TRAINING AND COGNITIVE FUNCTIONING IN AGING-ADULTS

By

PATRICIA ANN QUERRY

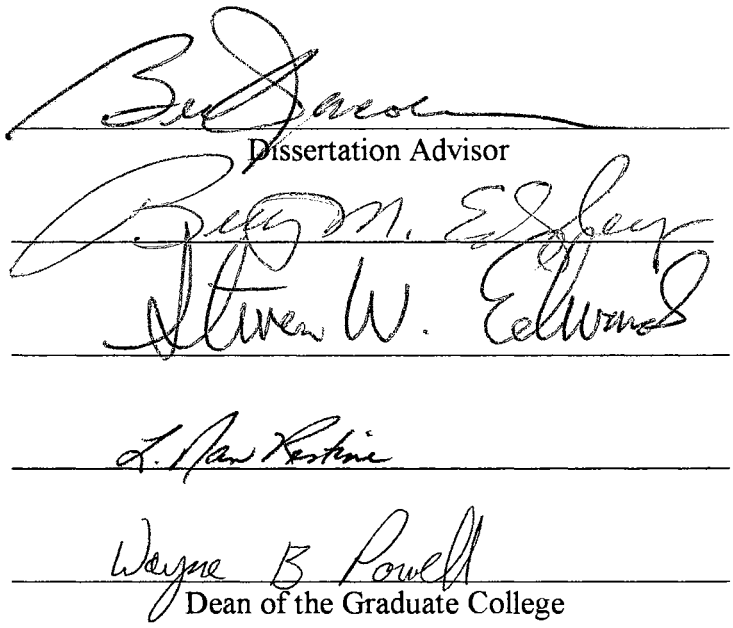
Bachelor of Science
University of Central Oklahoma
Edmond, Oklahoma
1988

Master of Education
University of Central Oklahoma
Edmond, Oklahoma
1990

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF EDUCATION
May, 1998

Effects of Aerobic Exercise Training and
Cognitive Functioning in Aging-Adults

Thesis Approved:



Dissertation Advisor

Dean of the Graduate College

PREFACE

In the past decade there has been an increasing interest in the relationship between mental functioning and aerobic fitness, particularly in older adults. This study was administered to obtain new knowledge that will enhance future programs promoting the health benefits of aerobic exercise training. Specific objectives of this research were to identify (a) the relationship of aerobic exercise to cognitive functioning, emphasizing memory recall and the behavior of the brain, and (b) changes in attitudes and behaviors of self concept resulting from an exercise program.

I sincerely thank my doctoral committee--Drs. Betty Edgley (Chair), Steve Edwards, Nan Restine, and Bert Jacobson--for guidance and support in the completion of this research.

ACKNOWLEDGMENTS

I wish to express my sincere appreciation to Dr. Betty Edgley, chairperson of my committee for her guidance, inspiration and genuine interest of the success of my coursework and study. My sincere appreciation extends to my other committee members Dr. Steve Edwards for his time, patience, and direction with the statistical computation of my research study, to Dr. Nan Restine for her encouragement and support, and to Dr. Bert Jacobson for his accessibility and research suggestions that provided a wonderful experience.

I wish to say a special "thank you" to my friends and colleagues, who provided suggestions and assistance for this study: participants of the research study, Jill Gantz (special support friend), Drs. Gerry Pinkston (spiritual mentor), Virginia Peters, Karen Dowd, Dorothy Marotte, Phil Ball and Karen Black.

I would also like to give special appreciation to my husband, Roger (my mentor), for his strong encouragement at times of difficulty, love and understanding throughout the entire process. Thanks also go to my children, Angie and Jason, my parents Eugene and Iris Page, and family for their continued understanding and encouragement. A special hug to my nephew, Daniel Fix, for his computer expertise.

Finally, I would like to thank God for the many opportunities and blessings: *For the race you have been chosen to run is impossible to finish on your own.*

TABLE OF CONTENTS

Chapter

INTRODUCTION

Effects of Aerobic Exercise Training and Cognitive Functioning in Aging Adults

Aging well is a self-initiated promotion of good health, philosophical well-being, and selection of opportunities that support achieving and maintaining a personally satisfying life. No amount of exercise, prayer, or wishful thinking can avoid the inevitable, natural degeneration that occurs within our skins the longer we live in them; it can only delay it at best. Is exercise predicated upon wishful thinking, or are there proven benefits? Why do older persons exercise, and does it contribute to aging well? (Fontane 1996).

Aging is marked by a steady decline in exercise capacity and in other measures of fitness, a decline that is accelerated by a sedentary (non-exercising) lifestyle (Steinhaus, Dustman, & Ruhling, et.al.). Substantial empirical studies have demonstrated the benefits of aerobic exercise on physiological functioning in older adults (Cunningham, Rechnitzer, & Howard, et.al. 1987; Kavanaugh & Shephard, 1978), but data regarding the potential benefits of exercise for psychological well-being and cognitive functioning are inconclusive.

Futhermore, studies have indicated that exercise may reduce anxiety among special groups of older adults, including patients with dementia (Schwab, Radar, & Doan, 1985). Past studies have also demonstrated improvements in cognitive functioning following acute physical exercise (Molloy, Beerschoten, & Borrie, et.al., 1988) and after a 4-month exercise program (Dustman, Ruhling, & Russell, et.al., 1984).

Exercise is usually regular, patterned, leisure time activity pursued to achieve desirable outcomes such as an improved level of general health or physical performance (Bouchard & Shephard, 1994) or the prevention or slowing of deterioration of the body's physiological capacities due to disuse and/or aging. Exercise is expressed in terms of duration (how long), frequency (how often), intensity (how hard), and mode (type of activity). Exercise ranges from vigorous (e.g., tennis) to moderate (e.g., brisk walking), to passive (arm flexions). A majority of older persons report they do not exercise regularly although they may enjoy active lifestyles that include such things as gardening, walking, and household maintenance (Fontane, 1996). Data from 1991 indicate that 62% of men and women above the age of 55 years live sedentary (non-exercising) lifestyles (Public Health Service, 1993a). Goal 1.5a of Healthy People 2000 (Public Health Service, 1991) indicates the federal government's ambitious guideline for improving the health of the nation's population by the year 2000 is to increase the proportion of people aged 65 and older who engage in leisure-time physical activity to 78%, compared to the proportion in 1985 of 57%.

Some researchers boldly assert that physical fitness is associated with longer life (Blair, Kohl, & Barlow, et.al., 1995; Fries, Gurkirpal, & Morfeld, 1992). Others are more modest, suggesting that 50% of aging decline would be avoided (O'Brien & Vertinsky, 1991), or that a number of ailments could be delayed by exercise (Ramotar, 1993), or that physiological decline, mislabeled "aging," is due to a lack of exercise (disuse) (Ward, 1994). Citing King, Taylor, & Haskell (1993), Ory & Cox (1994) declare, "Regular physical activity is now recognized as a critical element in the prevention of disease and enhancement of health in adulthood."

As the life expectancy increases in this country, cognitive impairment is becoming a highly prevalent condition observed in aging populations (Emery & Gatz, 1990). These studies have assessed the effect of the severity of impairment rather than the effect of the decline in cognitive functioning over time.

deVries (1975) suggests that cognition is a gradual decline of the central nervous system affecting measures of higher mental function (working memory, attention, visual, motor, short-long-term memory, perceptual processes and information processing speed) in the population of aging adults. He states that physically inactive lifestyles result (1) reduced cerebral oxygenation in old age, (2) may adversely affect brain function, and (3) increase the presence of atheroscleroses resulting in ability to efficiently transport and utilize oxygen.

The latter can be improved with aerobic exercise and is supported by growing evidence suggesting that the rate of the decline of physical and cognitive abilities is governed by a physical conditioning level as well as by age.

However, several studies indicate little or no effect of aerobic exercise on either cognitive functioning (Blumenthal, Emery, & George, et.al., 1989). or mood among older adults (Blumenthal, Schocken, & Needels, et.al., 1982). (Dustman, Ruhling, & Russell, et.al., 1984); Perri & Templer, 1985).

As the body deteriorates from its inability to replace cells as quickly as they are needed, the aging adult does not prepare for the daily maintenance management that enables the body to respond to physiological, physical, and psychological demands.

It is important to the aging population to provide programs to improve the individual's self-concept to the highest possible level of independent function. Successful programs can prepare the aging adult to become better educated and more involved in his or her own health maintenance.

JUSTIFICATION

This study will attempt to determine if there is a relationship between aerobic exercise training and cognitive function in adults 70 years and older. The results may be useful in convincing older individuals to engage in an aerobic exercise program that could improve cardiovascular endurance, self concept and mental functioning. The data collected may further influence the community and other elderly care facilities to provide programs that emphasize aerobic training.

STATEMENT OF THE PROBLEM

The purpose of this study is to compare the effects of a 12 week aerobic training program, a 12 week social interaction program, and a no intervention on measures of concentration short-term memory, attention span, recent memory and orientation of cognitive function, and a measure of relative self concept in a sample of non-exercising older adults.

HYPOTHESES

The following null hypotheses will be tested at the .05 level of significance. Each of the stated hypotheses will be examined to see if a difference occurs in cognitive functioning between the experimental and control groups in pre, mid, and post time periods and if an interaction exists between the groups in pre, mid, and post time periods.

Ho1: There will be no significant differences in the participants response to the Stroop Interference Test, between the pre-test, mid-test, and post-test following a 12 week aerobic exercise program.

Ho2: There will be no significant differences in the participants response to the word recall memory test between the pre-test, mid-test, and post-test following a 12 week exercise program.

Ho3: There will be no significant differences in the participants response to the Simon Says memory game between the pre-test, mid-test, and post-test following a 12 week exercise program.

Ho4: There will be no significant differences in the participants response to the self-concept test between the pre-test, mid-test, and post-test following a 12 week aerobic exercise program.

DELIMITATIONS

1. The subjects will be volunteers placed in one of three groups--exercise group control/interaction and control group.

2. The subjects are non-exercisers and have no previous experience in an exercise program for the last 3 years.

3. The Karvonen Formula will be used to determine a 60%-80% range of the maximum heart rate.

4. The exercise group will workout at 60%-80% of maximum heart rate reserve, 3 days per week for 12 weeks. Exercise sessions will be supervised by the investigator.

5. The control group will not participate in any aerobic exercise program during the 12 week period.

6. The Perceived Rate of Exertion (PRE) will be determined by the Burg measurement scale.

7. The study will be conducted for a period of 3 months during September through November, 1997.

LIMITATIONS

1. Daily activities of the experimental subjects other than the exercise program will not be controlled.

2. Since pre-existing illnesses and drugs can affect cognitive conditions, it is possible that such conditions do exist.

3. Although subjects in the control group will be requested to not participate in any exercise activities occasional variance from this will not be controlled.

4. Subjects were volunteers and not randomly selected.

ASSUMPTIONS

1. The physical and environmental influences are unique to each 70 years and older individual.

2 All subjects completing the exercise program will perform to the best of their ability each day.

3. The investigator working with this program will adapt the exercise routine to each subject as the subject progresses.

4. All control subjects will refrain from any aerobic activity.

DEFINITION OF TERMS

Aerobic is exercising "with oxygen" (Cooper, K., 1977).

Aerobic exercises involves continuos and rhythmic use of large muscles for at least 15 minutes on 3 or more occasions a week, at which an increase resting heart rate by 60% of heart rate reserve is accomplished (American College of Sports Medicine, 1995).

Aging includes all of the structural and functional changes that occur throughout the life span from embryonic development through maturation and senescence (Schlenker, 1993).

Attention is the process of focusing perceptual-motor systems on specific stimuli or tasks that are to be accomplished (Spirduso and Asplund, 1995).

Cognition are processes that may be described as three functions: cognitive supports, cognitive mechanics, and cognitive pragmatics (Spirduso and Asplund 1995).

Cognitive mechanics or fluid intelligence is basic information processing, including cognitive functions such as speed and accuracy of elementary processing, visual and motor short-and long-term memory, discrimination, comparison, and categorization (Baltes, 1993: Cattel, 1963).

Cognitive pragmatics or crystallized intelligence includes the cognitive functions of reading, writing, language comprehension, educational qualifications, and life skills (Cattel, 1963).

Cognitive supports are perceptual processess, information processing speed, working memory, attention, and psychomotor control (Salthouse, 1991).

Information processing speed is the alacrity with which neural impulses travel from one neuron to neuron, node to node, or neural network to network (Spirduso and Asplund, 1995).

Karvonen formula is the heart rate reserve method used to calculate a target heart range (Powers & Howley, 1997).

Perceptual processes are procedures such as coding visual, auditory, proprioceptive and tactile information (Spirduso & Asplund, 1995).

Psychomotor processing occurs when motor effectors, such as fingers, eye muscles, throat and lip muscles are integrated with cognitive mechanics to reflect information processing and to achieve cognitive pragmatics (Spirduso & Asplund, 1995).

Rate of perceived exertion is a scale used to prescribe exercise intensity for apparent healthy persons (Powers & Howley, 1997).

Self-concept is the structure and function of self, of how an individual conceptualizes his/her identity, and how one feels and thinks about life in general, about the present, about the past, and about the future (Bengtson, Reedy, & Gordon, 1985; Markus & Wurf, 1987; Whitbourne, 1985).

Simon Says is a game that tests memory by identifying a sequence of color/sound combinations (Milton Bradley, 1994).

Stroop Color Interference reflects abilities in the areas of visual scanning and tracking and the capacity to shift perceptual sets to determine intactness of the brain (Stoelting, 1994).

Working memory includes holding perceptions and memories in contact while operating on them (Cattel, 1963).

METHODS

This research involves a non-equivalent experimental/control group designed to investigate aerobic exercise training and its effects on and psychological function of 70 - year old males and females.

CHAPTER II

REVIEW OF LITERATURE

INTRODUCTION

In the last decade being "physically fit" has emerged as a major health issue for many Americans. Especially popular in developing and maintaining fitness are "aerobic" exercises such as fast walking, jogging, and swimming.

The literature concerning the impact of aerobic exercises on the biological and physiological functions of the elderly is limited, there has been much research conducted on the effects of aerobic exercise, generally. To better understand the influence of aerobic exercises on the elderly, this review will focus on three categories: (1) cognitive functioning (2) aerobic status, and (3) self concept.

Cognition

Cognitive functioning relates to an individual's ability to process information. There are several sources of variability that may account for differences in determining adequate cognitive functioning among the elderly.

Spirduso & Asplund (1995) describes cognition as three functions: cognitive supports, cognitive mechanics, and cognitive pragmatics. The complex cognition processes, or supports are described as perceptual processes, information processing speed, working memory, attention and psychomotor control.

The attempt to expand knowledge of age differences in memory abilities, by comparing younger and older adults on memory tasks involving activity memory, has been studied by several researchers (Backman & Nelsson, 1985; Cohen, Peterson, & Mantini-Atkinson, 1987; Kausler & Lichty, 1988). Simple action tasks, known as subject-performed tasks (SPTs)', require the subject to perform and recall a list of actions during encoding of the items. One interpretation of the age-related differences in divided attention performance is that older adults become deficient in the ability to flexibly coordinate and integrate concurrently performed activities or processes (Korteling, 1991; McDowd, Vercruyssen, & Birren, 1991).

Hasher & Zach's (1979) hypothesis states that cognitive functions can be placed on a continuum from automatic to effortful, and that aging degrades effortful cognitive function more than automatic function. Tasks that require only automatic functions may be described as self paced, single tasks, requiring little or no attention. Completion of these tasks can occur without awareness, performance is uninfluenced by other cognitive functions, and these tasks require minimal memory. Conversely, speeded or multitasks, which require intense attention, are influenced by strategy and imagery, and require high memory capacity are categorized as requiring effortful cognition and are most affected by aging.

In later studies by Hasher & Zacks (1988) research proposed that there is an age-related decline in the ability to inhibit the detrimental effect of irrelevant stimuli on the processing of task-relevant information preventing full concentration or attention on target information. This correlates with Craik's (1977) summary of the dual-task and aging literature suggesting that older subjects are more penalized when they must divide their attention. Even though earlier methodologies of the 1960's and 1970's were under critical review, more recent and methodologically sophisticated examinations of the relationship between aging and decrements in divided attention performance have, with few exceptions, obtained results that confirm the earlier findings (Koertling, 1991: McDowd, Vercruyssen, & Birren, 1991).

Unlike short-term or primary memory, working memory is important because it is considered a large contributing factor to success in other cognitive tasks (Salthouse, 1991). Working memory includes holding perceptions and memories in contact while operating on them. An example of working memory is mentally adding or multiplying numbers. (Spirduso & Asplund, 1995). Spirduso & Asplund also describe the last process among the cognitive supports as the psychomotor processing which is determined by motor effectors and muscles. This process becomes a front runner to cognitive mechanics which in turn reflect the information process (neuron to neuron) of the central nervous system in achieving cognitive pragmatics.

Cognitive mechanics along with cognitive pragmatics was coined by P.B. Baltes, (1993). It is a term others have described as fluid intelligence. Cattell (1963) explains that fluid intelligence can be collectively thought of as basic information processing including cognitive functions such as speed and accuracy of elementary

processing, visual and motor short-and long-term memory, discrimination, comparison, and categorization. Information processing speed is the speed and accuracy with which stages of processing are navigated. Visual and motor short-term memory is the process of remembering items and relationships for short periods of time, such as remembering a telephone number long enough to dial. Long-term memory is the process of retrieving information from long-term storage. Cattell (1963) further explains that fluid intelligence reflects the function of neurological structures, which begin to decline after neural maturation (adolescence) unless some kind of intervention takes place. In contrast, crystallized intelligence is thought of in terms of cultural assimilation and is highly influenced by formal and informal educational factors such as: reading, writing, professional skills, and life skills, (Cattel, 1963).

This dual-process categorization owes its birth to the learning psychologist Hebb (1949) who identified two kinds of intelligence, A and B and to the factor analyst Cattel (1963). He distinquished between the two second-order factors stated earlier, fluid and crystallized. Juxtaposing the cognitive mechanics with the cognitive pragmatics does not imply that the two categories are exclusive. In practice, they interact, of course, and in addition, the pragmatics always build on the mechanics. (Baltes,1993).

Kleigl & Baltes, (1990) has developed two prototype experimental paradigms: One focusing on memory, the other on wisdom. For both of these, Baltes, has tried to study functioning at the highest levels of performances using concepts and methods associated with theories of specialization, expertise, and testing of limits for both of these paradigms.

The goal of Baltes & Smith (1990), Baltes & Staudinger (1993), Dittmann-Kohli & Baltes (1990), Smith, Dixon, & Baltes (1989), and Staudinger (1989) was to formulate a psychological life-span developmental model of wisdom and to examine its utility in terms of scope, precision, and deployability. These authors have pursued three lines of research on: (1) cultural historical conceptions of wisdom (capstone of the human mind), (2) subjective or everyday conceptions of wisdom (this is often attributed to elderly persons) (Heckhausen, Dixon, & Baltes, 1989) and (3) the ontogenetic development of performance in wisdom related tasks (empirical paradigm - observing the latent potential of the aging mine in action, and understand the power of culture in shaping the course of the aging mind on the level of performance rather than in subjective representations).

Stones & Dawe (1993) studied the acute effects of non-strenuous physical exercise on memory retireval and visuo-motor performance in older-old nursing home residents. Of the 20 participants, four were males and 28 were females. These volunteers were assigned to either an exercise group, a control interaction group or a non-interaction group. The mean age of the sample was 84.5 years (range 70-93 years). The subjects included in the study were ambulatory, willing to participate, were not former participants in formal exercise, had no medical contraindications for non-strenuous exercise, and scored in the normal range on the Mental Status Questionnaire. The modified SET (word fluency task with semantic categories) was presented along with the Symbol Digit task and a lexical memory test that represents word fluency to an initial letter category. The exercise protocol used for the experimental group consisted of chair exercises and low intensity

aerobic activity that involved slow rhythmical movement of all body parts. The control group watched a video of similar exercises for a comparable interval. A pre-post-test was administered to all participants with the modified SET test evidencing a gain of 20% of cardiovascular conditioning after exercise; however, no exercise effect was obtained on the Symbol Digit nor the other word fluency task. Findings are encouraging from an applied perspective in that an aspect of neuropsychological performance in the old-old did show gain after a brief bout of exercise. The Molloy, Beerschoten, & Borrie et.al. (1988) helped to confirm neuro-psychological gain after a bout of exercise in a geriatric sample of 15 subjects mean age 66 years. A pre-post-test crossover design with a nine-measure neuropsycho-logical battery before and after each 45 minutes of non-strenuous exercise and rest conditions was administered. Although the use of a multi-measure battery in a cross-over design confounds effects due to exercise with those of fatigue and practice, significant gain after exercise was noted on two measures, the Mini Mental State Examination and memory for prose.

Dustman, Ruhling, & Russell et. al. (1984) found significant improvement on Critical Flicker Fusion, Digit Symbol, Dots Estimation, Simple Reaction Time, and Stroop tests on aerobically trained individuals age 55-70 years. However, Emery and Blumenthal (1990) examined 101 subjects age 60-83 years (M=67 + 5) and found no significant improvements on the Digit Symbol and Digit Span subtest from the Wechsler Adult Intelligence Scale Revised (WAIS-R; Wechsler, 1981) or the Trail Making Test (Reitan, 1958).

Cognitive funtioning relates to an individual's ability to process information. It is considered to reflect functioning of neurological structures and increases until the cessation of neural maturation (adolescence) and is believed to decline thereafter unless some kind of intervention takes place.

Aerobic Effects

In the past decade there has been an increasing interest in the relationship between mental functioning and aerobic fitness, particularly in older adults. Exercise has been demonstrated to have positive effects on cardiovascular risk (Paffenbarger 1986, Pekkanen, Nissinen, et al, 1987), aerobic power (Barry, Caly, & Pruett et. al, 1966), muscle strength (Fiatarone, O'Neill, & Ryan et. al., 1994), osteoporosis (Chow, Harrison, & Notarius, 1987), cerebral function (Spirduso, 1980), blood pressure (Tipton, 1984), obesity (Sidney, Shephard, & Harrison, 1977), mood (Ingebretsen, 1982), and increased social contact (Shepherd, 1990) in the young old (under age 75). A more recent account of aerobic effectiveness by (ACSM, 1997) substantiates earlier findings of the numerous benefits of aerobic exercise:

^You will look better and feel better.
^Your heart and lungs will get stronger.
^Aerobic exercise increases your maximal oxygen uptake (V02max).
^You will lower your resting heart rate. This means your heart does not have to beat as frequently, in order to deliver enough blood to all parts of the body.
^If you have elevated blood pressure, aerobic exercise will help to normalize it.
^If you have high blood cholesterol, aerobic exercise will help normalize it.
^Aerobic exercise increases the oxygen carrying capacity of the blood and increases the ability of skeletal muscle to utilize the oxygen.
^Aerobic exercise increases the number and size of the mitochondria (the powerhouse of the cell).
^Regular aerobic exercise is essential for weight management, and elevates your metabolism so you keep on burning calories efficiently.
^It improves posture and total body alignment.
^It helps to relieve stress and tension and anxiety.
^Exercise alleviates the discomforts associated with menstruation and menopause.

^It enables the body to fight off infection; active people get sick infrequently.
^You will sleep better.
^ Exercise helps you to maintain lean muscle mass.
^You will be able to concentrate better and work more productively.
^People who exercise tend to have a positive outlook, a cheerful disposition, and endless energy.

The American College of Sports Medicine (ACSM, 1997) defines aerobic exercise as "any activity that uses large muscle groups, can be maintained continuously, and is rhythmic in nature." The basic guidelines for aerobic exercise governed by the ACSM recommends that frequency, intensity, duration, and type of exercise be determined and maintained to acquire positive results. Although strength and flexibility are significant components of physical fitness, cardiovascular endurance, or more popularly called aerobic capacity, is the most important in terms of overall health benefits.

Aerobic "with oxygen" aerobic capacity is actually measured by how much oxygen is taken in by the body during exercise, and how efficiently the oxygen is extracted by skeletal muscle. The exchange of oxygen and carbon dioxide takes place at the cellular level, and dramatically affects physiological performance. (Cooper, 1977).

A link among cerebral oxygenation, cardiac output, advancing age, and mental functioning is suggested by a large body of research that has demonstrated that declines in cardiovascular function in the elderly can be reversed, in part through participation in aerobic exercise programs (deVries, 1970; Kannel, Belanger, D'Agostino, & Israel, 1986; Salten, Hartley, & Kilborn, et.al, (1969) and a growing body of literature suggesting that there may be an associated reversal of the decline experienced in some cognitive functions. (Hawkins, Capaldi, & Kramer, 1992).

The brain is the primary beneficiary of aerobic fitness. The brain weighs only two to three percent of one's total body weight, yet it takes as much as 40-50% of all the oxygen one inhales, (Buzan, 1994). The brain is conveniently subdivided into three parts: the brain stem, cerebrum, and cerebellum. The brain stem consists of a complicated series of nerve tracts and nuclei (clusters of neurons) and is responsible for many metabolic functions, cardio-respiratory control and receives and integrates information from all regions of the central nervous system (CNS) and works with higher brain centers in controlling muscular activity. (Bagby, Sembrowich, & Gollnick, 1972, Hunt, 1991).

The cerebrum is the large dome of the brain that separates right and left cerebral hemispheres. It contains over eight million neurons and performs three important motor behavior functions (Black, 1991; Gollnick & Saltin, 1983): (1) organization of complex movement, (2) storage of learned experiences, and (3) the reception of sensory information. The cerebellum plays an important role in coordinating and monitoring complex movement. Even though complete knowledge about cerebellar function is not presently known, evidence exists to suggest that its primary role is to aid in the control of movement in response to feedback from proprioceptors (Gallnick & Saltin, 1983).

Because of the intimate connection between the body and the mind, physical fitness can now be seen to be equivalent to mental fitness, as the body will produce more blood in response to the demand for more oxygen (remembering that the red blood corpuscles transport oxygen). This allows the body, its brain and senses to function more naturally. (Buzan, 1994).

deVries (1975) also suggests that oxygen transport can be improved by aerobic exercise, and a growing evidence implies that the rate of decline of physical and cognitive abilities is governed by physical conditioning levels as well as by age. It is generally considered that oxygen itself may not play the major role in cerebral functioning (Libow, 1974; Sokoloff, 1966, 1976) implicating the changes in brain chemistry are a result of aging.

Elsayed, Ismail, & Young, (1980) states that the availability of circulating glucose as a nutrient to the brain may also be an important factor in changes in higher level cognitive processes. They intimate that it is a well known fact that the preferred source of energy for the physically active individual is fatty acid rather than circulating glucose which is the essential nutrient to the central nervous system (CNS). Consequently there is reason to believe that when individuals become physically fit they are likely to have an abundance of circulating glucose which can be transported efficiently (in this case to the brain) for nourishment.

Every cell consumes oxygen in order to convert food energy to usable ATP (adenosine triphosphate). Without sufficient amounts of ATP most cells die quickly. (Powers & Howley, 1997). Muscle cells that are contracting have high demands for ATP. The sum total of billions of cells throughout the body consuming oxygen, and generating carbon dioxide can be measured at the breath using a combination of volume-measuring and oxygen-sensing equipment (Seiler, 1996).

According to Seiler (1996) several experiments of different types support the concept that it is oxygen delivery, not oxygen utilization that controls the limits of V02 max. There are two factors which seem to contribute to reduced

cerebral oxygenation in old age and thus may adversely affect brain function: the increasing presence of atherosclerosis and an inability to efficiently transport and utilize oxygen resulting from physically inactive lifestyles. (deVries, 1975)

Neuroscientist Greenough, (1996) study with rats demonstrated two major effects of aerobic activity: aerobic exercise fuels the brain with more nutrients and skill based exercise increases the number of synapses, or CNS connections, which some scientists theorize may make the brain better able to process information.

This correlating with psychologist Kramer (1995) at the University of Illinois demonstrated that 40 sedentary adults, aged 63-82, could hit buttons faster in response to a tone after they went through a 10-week water aerobics course. The control group that didn't exercise showed no improvement.

Dustman, Emmerson, & Ruhling, et.al., (1990) studied the effects of age and fitness on EEG, ERP's, Visual Sensitivity, Sternberg reaction time, Stroop Color Interference, Symbol Digit Modalities, and Trails B. These tests reflect abilities in the areas of response, speed, attention, visual scanning and tracking. They also include the capacity to quickly shift perceptual set, abilities that they previously found to be related to aerobic fitness levels. These points improved cardiovascular fitness, increased oxygen utilization (V02max) indicating more efficient transport and delivery of oxygen to consumer cells. Significant improvements in body composition and muscle function determined somewhat less anticipated reports of positive influences at the cognitive/affective levels.

In contrast, early studies suggest that cognitive function was not affected by exercise. In one such study, Barry, Steimentz, & Page, et.al, (1966), found improved performance on imaging and color discrimination after a 3 month aerobic program but they found no improvement on a variety of working memory and discrimination tasks. A later study administered by Madden, Blumenthal, & Allen, et.al., (1989) on improving aerobic capacity in healthy older adults did not lead to improved attention and memory retrieval as well.

Self - Concept Effects

The structure and function of the self (Bengtson, Reedy, & Gordon, 1985; Markus & Wurf, 1987; Whitbourne, 1985), in an individual conceptualizes his/her identity and how one feels and thinks about life in general about the present, about the past, and about the future is another domain embodied by the pragmatics of the mind. Within this domain, there is increasing evidence about the resiliency and pragmatic power of the aging mind especially in the management of the shifting balance of gains and losses (Baltes, 1991; Baltes & Baltes, 1990; Brandtstadter & Greve, 1994; Brim, 1992; Heckhausen & Schulz, 1993).

That the aging mind continues to have much plasticity for reorganization of the self, and that this change in the self can be related to the topic of selective optimization with compensation. This is perhaps best illustrated by research on indicators of selfhood such as self-esteem, the sense of personal control, or measures of well-being or life satisfaction (M. Baltes & Baltes, 1986; Filipp & Klauer, 1986; Lachman, 1986; Ryff, 1991).

Several processes of cognitive pragmatics dealing with pragmatics of self have been identified as immunizing conditions, protective factors, and coping strategies which allow individuals to develop and move forward in personality growth. These strategies are identified as: (1) activation and changing use of different possible selves, (2) changes in levels of aspiration and expectations, (3) changes in goals and goal structures, and (4) changes in processes of social comparisons and use of social norms (Baltes & Baltes, 1990).

As to the first strategy of self-management and reorganization, (Markus & Hertzog, 1991; Markus & Wurf, 1987), the self actually involves multiple selves. It is a system of possible selves or orientations in selfhood. Most humans have a set of conceptions about who they are, who they were, who they would like to be, and who they would not want to be at all. As one moves through life and deals with new developmental tasks, or as one self is challenged, another self can be activated and unfold.

A second and third strategy of the pragmatics of the self are changes and transformations in levels of aspirations and the content and structure of goals. Such changes, of course, are part of the general life-span scenario of age-related changes in developmental tasks and associated potential for growth. Such changes are also associated with aging-related shifting ratio of gains and losses. When certain goals cannot be achieved reserve capacities allow the content and structure of goals to be altered, transformed or new goals identified and brought into the foreground. (Brim, 1992; Dittmann-Kohli, 1992; Ryff, 1991).

A fourth powerful strategy in the construction and transformation of the self is based on the mechanism of social comparison and especially the process of upward or downward comparison (Brim, 1992; Heckhausen & Krueger, 1993; Taylor & Lobel, 1989; Wood, 1989). This principle involves a change in the reference persons or social norms which are used as comparisons when constructing one's personal standard and sense of self. By focusing on different comparison persons, one is able to reorganize the frame of reference and evaluate standards.

Processes of self-construction and self-transformation in old age, are domains in which the pragmatics of the aging mind exhibit their potential, not unlike the area of wisdom. Self has a remarkable level of adaptive capacity for resiliency and maintaining a positive sense of self. There is evidence that on average older persons become more effective in the use of this adaptive feature of the self system as a "kind of protective shield against the adversities associated with becoming old" (Baltes, et al., 1992)

Cross & Markus, (1991) found future self-perceptions of "hoped for" and "feared" conditions were more influential upon health behavior than aagreement with general health values.

Self-perception involves how "well" the person is and desires to be. It is dependent upon the condition of health, including an acceptable or given level of illness, disability, or inconvenience the persons will accept as antecedent to a target quality of life (Fontane, 1996). Self-perceptions are an important aspect of individual functioning in that they are thought to be related to self-efficacy (Bandura 1977) which is itself a useful indicator of psychological well-being. Rosenstock's (1974)

health belief model expressed as self-efficacy is the confidence in one's ability to successfully attain a desired outcome. This coupled with Mcauley's (1993) review of self-efficacy research concluded that physical activity is positively related to personal efficacy. Grembowski (1993) found that older persons who have high self-efficacy beliefs also seem to maintain an internal consistency among outcome expectations and related, specific behaviors (regarding exercise, dietary fat, wieght control, smoking, and alcohol consumption).

The effects of aerobic exercise upon psychological health are not clear as with physiological health. Metz, Tanebaum, & Sagiv (1988) and Gitlin, Lawton, & Windsor-Landsberg, et.al., (1992) learned that although exercisers "felt better," the psychological indicators were not statistically significant among healthy, elderly volunteers. Stewart, King & Haskell (1993) found that exercise improved physical health but generated no change in indicators of psychological health among men and women 50-65 years of age.

Emery & Gatz (1990) examined the effects of a 12 week aerobic exercise program on psychological well-being and cognitive functioning in a group of 48 men and women with a mean age of 72. Subjects were randomly assigned to three groups: aerobic exercise training, social activity control, and waiting list. Exercise classes lasted approximately one hour and sessions were held three times a week. Exercise participants monitored their own heart rates and were instructed to maintain their heart rate at approximately 70% of age-adjusted maximum (i.e., 220 - age).

The social activity control group met three times per week for 1 hour and participated in nonphysical activities including card games, art projects, political discussions groups, and viewing humorous film strips.

Participants in the exercise group, and the two control groups underwent phyiological and psychological assessments prior to entering the study, and again after 12 weeks. Physiological tests consisted of heart rate, blood pressure, weight, flexibility, and heart rate response during a modified step-test (Minister of State, 1979). Psychological tests included measures of mood and locus of control. Mood was assessed with three measures: (1) Center for Epidemiological Studies-Depression Scale (CES-D) (Radloff, 1977); (2) a one-item self-rating of anxiety also taken from CES scales; and (3) a one-item self-rating of avowed happiness (Bradburn, 1969). Locus of Control was assessed with three measures, 1) Rotter Internal-External Scale (Rotter 1966); 2)Pearlin Mastery Scale (Pearlin & Schooler, 1978); 3) Lau and Ware Health Locus of Control Scale (Lau & Ware, 1981). Cognitive Functioning test measured fluid intelligence with the (1) Digit Span subtest from the Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1981); (2) Digit Symbol subtest from the WAIS-R (Wechsler, 1981); and (3) two tests of writing speed-writing digits and writing words from the first NIMH longitudinal study of normal aging (Birren & Botwinick, 1951).

Results from the study did not appear to contribute significantly to improvements in physiological functioning or psychological well-being, and the correlational analyses provided only limited support for the association of physiological improvement with enhanced cognitive functioning and personal mastery.

Aerobic exercise fitness of the elderly has also been linked in association with increased self-confidence (Mcauley 1993) and positive attitude toward life (King, Taylor, & Haskell, 1993; Maroulakin & Zervas, 1993), as well as improved self-concept and perceived internal locus of control (Blumenthal, Emery, & Madden, et.al., 1989).

Hill, Storandt, & Malley (1993) showed significant effects on a study of long-term aerobic training and psychological function. They examined 87 sedentary older adults who engaged in a year-long endurance exercise training program compared with a nonexercising control group. Improvements were noted on cardiovascular fitness and a positive change in self-reported morale was found for the exercise condition.

Summary

The physiological and psychological effects of aerobic exercise training have been examined. Aging well places importance on cognitive function and self-concepts of exercise and the desirable outcomes to be achieved as well as undesirable conditions to be avoided by the older person (Fontane 1996).

Experimental studies of the relationship between aerobic fitness and cognitive performance have largely focused on the evaluation of fitness effects on the speed of behavior. Fewer studies have directly investigated the relationship between aerobic exercise and cognitive performance most likely to occur to tasks requiring high memory capacity, strategy, imagery, or any effortful cognition.

A serious shortcoming of the aerobic exercise and cognition literature is the lack of information pertaining to the mechanism or mechanisms by which aerobic exercise training may influence cognitive performance in old age. While several authors have

speculated that high levels of aerobic fitness may be associated with such factors as improved cerebral blood flow, elevations in cerebral metabolism, and increased nutrient supply to the brain. These explanations have yet to be subjected, for the most part, to a large body of experimental test (Chodzko-Zajko 1991).

The health benefits of exercise have been well established among the younger segment of the older population and middle-aged and young people. However, the issue of whether exercise affects cognitive and neurobehavioral function in the 75 and older group remains controversial (Kiyohito, Kozo, & Tomoko, et.al., 1996) and leaves the potential risk associated with vigorous exercise and heterogeneous physical activity in advanced age groups difficult to formulate effective forms of exercise. (Holloszy 1983).

This analysis of the literature on aerobic fitness training and its effects on cognitive functions in aging adults suggests that researchers' understanding of this topic is not as clear as is desired and that exercise is not a panacea for all older adults (Holloszy 1983).

Although these relationships of specific cognitive functions to specific measures of aerobic fitness have not been substantial, they indicate a difference too high to occur by chance alone, warranting further examination of the correlational relationships.

CHAPTER III

METHODS

Subjects

The subjects consisted of 32 elderly volunteers, 29 women and four men, ranging in ages 70-93 with an average age of 79.21 (±6.8) who were non-exercising, independent, community dwelling adults. The subjects had not participated in any kind of physical activity for the past three years and were willing to participate three days per week, for 12 weeks. Subjects agreed to progress to a 45-60 minute individualized progressive aerobic exercise training program or remain in one of two control groups.

Each subject voluntarily read, signed, and dated an informed consent form approved by the Institutional Review Board at Oklahoma State University (Appendix A). This procedure occured after subjects had been informed of the study, purpose, procedures, and potential risk of the aerobic exercise program.

Subjects completed a health screening information form concerning medical history previous aerobic activity, education and general information (name, age, etc.) along with a release of liability forms. This questionnaire, was used to assess previous activity levels and to eliminate from the study any volunteer who had participated in any type of regular

exercise program within the last three years. Participants selected for the study were judged (according to the self-report questionnaire) to be free of any physical or health impairments that might preclude their participation in an exercise program or might hinder their performance on the tests.

Subjects were encouraged to comply with the study proceedings. The control groups were asked to refrain from entering into any formal form of aerobic exercise training. The experimental group was encouraged to not participate in any form of additional exercise while participating in the fitness program. Subjects were directed to inform the investigator of any ill feelings following the test proceedings.

Subjects were grouped on a volunteer basis in either an experimental group, a control/interaction group, or a non-interaction group, were pretested prior to the study and retested at mid (6weeks), and again at the end of the post (12week) proceedings. Physiological and Psychological testing took place at the Special Service Center in Edmond, Oklahoma. This location was chosen for convenience, adequate space and availability. All subjects were given the Word Recall Test, StroopWord/Color Test, Simon Says, and Tennessee Self Concept Test #2, along with the administering heart rate test and blood pressure measurement. On test day each subject arrived on time and the investigator administered the test protocols.

The exercise group consisted of 12 female volunteers who were first-time participants in an aerobic exercise program taught at the Special Service Center. Subjects in the control/interaction group were 11 female volunteers and 1 male volunteer who participated in social activities such as; sewing, bingo, and Skip-Bo. The control group were 10 female volunteers, and 3 men with no participation involved. During the

12 week study, one subject was lost from the exercise group, one subject was lost from the control/interaction group, and three subjects were lost from the control group. The final number of participants were 11, 11, and 10 respectively. Dropouts from the study were due to illness or surgery. The exercise subjects participated three times a week for 12 weeks in an aerobic exercise training program taught by the assistant investigator. The classes, which were designed to meet the Rockport Walking Fitness Test Levels (1997) (see Appendix E), included 10 to 15 minutes of warm-up activities, 20 minutes of aerobic walking at an intensity level of 60% - 70% of maximum heart rate (MHR), using the Karvonen method of calculating target heart rate range (THR-R), and the Borg scale (Powers & Howley 1997) for determining the rate of perceived exertion (RPE), and 5 - 10 minutes of cool down activities. More specifically, the warm-up exercises included a combination of limbering activities and static stretching and range of motion exercises at low intensity exercise to music routines (e.g., overhead arm stretch, calf and achilles tendon stretches, hamstring stretches, trunk twister, pelvic tilt, stretches for the low back and groin, shoulder stretches and rotations, hand and wrist rotations, ankle and foot circling, neck extensions, and trunk and hip flexion and extensions, (Flexibility for Sport & Fitness, Human Kinetics, 1997).

Tubing exercises were designed to maintain and /or improve muscular strength and endurance, balance, and coordination (e.g. arm curls, chest, upper back, shoulders, biceps, triceps, quadriceps, and one-leg balance). The cool-down period consisted of static stretching and relaxation activities similar to the stretching activities performed in the warm-up. Although cardiorespiratory endurance was not a major variable of interest in this study, the heart rate (HR) was checked immediately after exercise,

taking a fifteen-second pulse count and multiplying times four. Pulse was measured at the radial artery or the carotid artery using only light pressure since heavy pressure can slow HR. THR range was determined by using the Karvonen method (1957) Heart rate reserve (HRR), using 3 simple steps. These steps are:

1) Subtracting resting HR from maximal HR to obtain HRR reserve (HRR)

2) Take 60% and 80% of the HRR

3) Add each HRR value to resting HR to obtain the THR range.

HR max = 220 - age
HR max = 220 - 70 (example) = 150
HR rest = 70
HRR = 150 - 70 = 80
Lower HR = HRrest + (HRR x 0.6)
= 118
Higher HR = HRrest + (HRR x 0.80)
= 138
Training heart rate range 118 - 134 bpm

After the target heart rate has been determined all future exercise intensity was monitored based on the participant's rating of perceived exertion (RPE) derived from the Borg scale.

The Rockport® Fitness Walking Test, an aerobic workout according to the subject's age and sex, was used for the experimental group. This program has 5 fitness levels with level one as the beginning level continuing to the most difficult level 5. Charts were provided to monitor distance/time for each exercise session. By using the relative fitness level chart, subjects found their speed and their minute heart rates (See Appendix D).

Measurements

All cognitive tests, pre-mid-and post-tests, were repeated on occasions during a one week period The pre-mid-and post-tests began with the investigator reading the instructions related to each of the four tests. Each subject completed the Word Recall Test, the Stroop Word/Color Test, Simon Says® and the Tennessee Self Concept Test #2 and the results were recorded after each testing session (pre-mid-and post) on a data sheet (See Appendix D).

Test responses to the Word Recall Test were determined by the subjects at one second intervals, with the subject repeating the word or words back in the same sequential fashion. The subject began repeating the word or words after the investigator finished the word with "and", that was the subjects clue to respond. Scores were determined at the pre-mid-and post-test, with the subject's score being determined by the last word repeated correctly.

The Stroop Word/Color Test consists of three parts. Each part had 100 items, presented in 5 columns of 20 items. Part 1 consisted of the words "RED", "GREEN", and "BLUE", arranged randomly and printed in black ink on a white 8 1/2 x 11 sheet of paper. No word was allowed to follow itself within a column. Part 2 consisted of 100 items, all written as "XXXX", printed in either red, green, or blue ink. No color was allowed to follow itself in a column, nor to match the corresponding item on Part 1. For example, if the thirteenth item on Part 1 was red, the thirteenth item on Part 2 could not be printed in red ink. Part 3 consists of the words on Part 1 printed in the colors on Part 2. The two pages were blended item for item: Item 1 on Part 1 is printed in the color in Item 1 on page 2 to produce Item 1 on Page 3. In no case did the

word and the color it was printed in match. Method of scoring was employed by the items completed in 45 seconds. Part 1 was a test of how fast subjects could read the words on the page. After the investigator said begin, the subject read down the columns starting with the first left most column, and repeated without stopping down the remaining columns in order. Part 2 was a test of how fast the subjects could name the colors on the page, with the same procedure as on page 1. Part 3 the subject named the color of the ink the words were printed in ignoring the word that was printed in each item. Scoring for the Stroop Test was determined by using the T-scores from each part of the test and recording findings on the data sheet.

Simon Says (Milton Bradley, 1994) is a test of color, auditory, and memory sequence recall. Each subject began by pressing the same color. Next, each subject was allowed to push any color he/she wished, and had to recall the sequence that had been established. Subjects were scored by the correct number of recalled sequences.

The Tennessee Self-Concept Test (Western Psychological Services, 1996) was a written test in which subjects answered questions that pertained to their identification of self. The answers were obtained by a 5 point Likert-like scale and subjects were given ample amount of time to finish. Scoring was measured using T-scores determined by computer software Statistical Package for the Social Sciences, (SPSS, 1997).

All participants were given a self concept test, administered orally, with questions requiring a 5 point Likert-like scale response. These scores were not absolutes but provided a framework to begin to assess the subject's psychological disposition. The Stroop Word /Color Test, Word Recall Test, and Simon Says were evaluated using T-Scores analyzed by SPSS.

Statistical Treatment utilized was a within subjects research design, using a repeated measures analysis of variance (ANOVA) from SPSS to test for significance between pre-mid-and post tests responses on the four tests using the three groups (Word Recall, Stroop Word/Color, Simon Says, and Self-Concept.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter is divided into the following sections: a) analysis of hypotheses data and b) discussion of results. This investigation compared the effects of aerobic exercise on social and on interaction cognitive functioning and self concept among males and females over 70 years of age. Participants were administered three memory tests and one self-concept test. The mean ± standard deviation for age of the subjects was 79.21 (± 6.8) years (See Appendix F) for complete statistical analysis on all four test administered to all subjects, Stroop Interference Word/Color, Word Recall, Simon Says, and Tennessee Self Concept#2.

Data was collected from 32 subjects, 28 women and 4 men. Four hypotheses were tested to determine if there were significant differences, over time, in cognitive functioning and self concept following a 12 week aerobic exercise program. Repeated measures of analysis (ANOVA) were used to analyze the treatment effects as indicated by the scores on the memory and fifteen part self concept tests. Significant pairwise differences were determined using the Newman-Keuls post-hoc test.

Hypotheses

Four hypotheses were evaluated in this investigation using the 0.05 level of significance. Each of the stated hypotheses was examined to see if a difference occurred among the experimental, control/interaction, and control groups or among any of the time periods and to see if an interaction existed between the groups and the time periods.

Hypothesis I

It was hypothesized that there would be no significant differences in the participants response to the Stroop Interference Test, among the pre-test, mid-test, and post-test following a 12 week aerobic exercise program. The Stroop Interference Test consists of three parts, the Stroop color test, the Stroop word test, and the Stroop color word test. The means and standard deviations for this variable can be seen in Appendix F., Table II.

A repeated measures ANOVA was conducted using the Stroop Interference Test to determine if any differences occurred when comparing the main effects of group and when comparing the main effects of time examining if the interaction exist among the groups and time periods. (Table V)

The mean scores of the experimental group, the control/interaction group, and the control group were found to be non-significant at all three time periods. The repeated measures ANOVA showed no significant differences among the main effects of group; however, the main effects of time revealed significant differences at $F = 3.912$.
A Neuman-Keuls post hoc analysis showed no significant interactions with time, resulting in the significance being the result of the learning effect. Consequently, aerobic exercise did not have an impact on the participant's ability to respond to the Stroop Interference test. The null hypothesis was rejected.

TABLE V

REPEATED MEASURES ANOVA TABLE
OF STROOP INTERFERENCE TEST,
COLOR/WORD

SOURCE	SS	df	MS	F
GROUP	288.655	2	144.327	0.463
ERROR	9046.012	29	311.931	
TIME	345.722	2	172.861	*3.912
GROUP X TIME	136.66	4	34.165	0.322
ERROR	2562.861	58	44.187	
TOTAL	12379.810	95		

* SIGNIFICANT AT THE P<.05 LEVEL.

Hypothesis 2

It was hypothesized that there would be no significant differences among the experimental group, control/interaction group, control group responses to the word recall memory test among the pre-test, mid-test, and post-test following a 12 week exercise program. The means and standard deviations for this variable can be seen in Appendix F., Table III.

A repeated measures ANOVA was conducted using the Word Recall Memory Test to determine if any differences occured by comparing the main effects of group and when comparing the main effects of time examining if the interaction exist among the groups and time periods.

As shown in Appendix F, Table III, the mean scores of the experimental group, control/interaction, and of the control group were found to be non-significant at all three time periods. The repeated measures ANOVA conducted showed no significant

differences among the main effects of group, however the main effects of time revealed significant differences at F = 38.03. (Table VI.)

A Newman-Keuls post hoc analysis showed no significant interactions with time, resulting in the significance being the result of a learning effect. Consequently, aerobic exercise did not have an impact on the participant's ability to respond to the Word Recall Memory test. The null hypothesis was rejected.

TABLE VI

REPEATED MEASURES ANOVA
OF WORD RECALL MEMORY TEST

SOURCE	SS	df	MS	F
GROUP	0.59	2	0.3	0.29
ERROR	29.41	29	1.01	
TIME	30.65	2	15.33	*38.03
GROUP X TIME	2.19	4	0.55	1.36
ERROR	23.38	58	0.4	
TOTAL	86.22	95		

* Significant at the P<.05 level

Hypothesis 3

It was hypothesized that there would be no significant differences among the experimental group, control/interaction, and control group responses to the Simon Says memory game between the pre-test, mid-test, and post-test following a 12 week aerobic exercise program. The means and standard deviations of the participants response are noted in Appendix F, Table III. The mean scores (of the experimental group, of the control/interaction group, and of the control group found no significant difference at the three time periods.

The repeated measures ANOVA showed no significant differences among the main effects of group, and no significant differences among the main effects of time. Therefore, aerobic exercise did not make an impact on the participant's ability to react to the Simon Says memory test. The null hypothesis was rejected.

Hypothesis 4

It was hypothesized that there would be no significant differences among the experimental group, control/interaction group, control group response to the self-concept test between the pre-test, mid-test, and post-test following a 12 week aerobic exercise program.

The Self-concept Test consists of fifteen parts, Academic/Work (ACA), Behavior (BHV), Conflict (CON), Faking Good (FG), Family (FAM), Identity (IDN), Inconsistency (INC), Morality (MOR), Personal (PER), Physical (PHY), Response Distribution (RD), Satisfaction (SAT), Self-criticism (SC), Social (SOC), and Total Self-concept (TOT). The means and standard deviations for this variable can be found in Appendix F, Table IV.

A repeated measures ANOVA was conducted using the 15 scores from the Self Concept Test to determine if any differences occurred when comparing the experimental group, the control/interaction group, and the control group, when comparing pre-study scores, mid-study scores, and post-study scores by comparing the main effects of group and by comparing the main effects of time if the interaction exist among the groups and time periods. (Table VII)

TABLE VII

REPEATED MEASURES ANOVA TABLE
OF SELF-CONCEPT TEST,
RESPONSE DISTRIBUTION

SOURCE	SS	df	MS	F
GROUP	236.743	2	118.372	0.345
ERROR	9937.548	29	342.674	
TIME	37.861	2	234.9	*6.966
GROUP X TIME	283.347	4	70.837	2.11
ERROR	1947.424	58	33.576	
TOTAL	12874.862	95		

* Significant at the P< .05 level.

As shown in Table III, (Appendix F) there were no significant difference in the groups' mean scores over the twelve week period of time in the 15 part self concept measure. The repeated measures ANOVA conducted yielded no significant differences among the main effects of group, however the main effects of time revealed significant differences at the Response Distribution section and the Social section of the self concept

test, with the Response Distribution section showing a significant F equaling 6.966 (Table VII). The Response Distribution (RD) indicates how extreme a person's responses were to the Self Concept Test. High responses reflect a somewhat higher level of certainty than is expressed by most people. High scores would indicate that individuals may sometimes appear flippant and impulsive.

TABLE VIII

REPEATED MEASURES ANOVA TABLE
OF SELF-CONCEPT TEST,
SOCIAL

SOURCE	SS	df	MS	F
GROUP	177.449	2	88.724	0.4
ERROR	6437.124	29	221.97	
TIME	290.465	2	145.233	*3.682
GROUP X TIME	42.433	4	10.611	0.269
ERROR	2287.703	58	39.443	
TOTAL	9235.174	95		

*Significant at theP<.05 level.

The Social significant F = 3.682 (Table VIII). The Social (SOC) score is intended to measure how the client perceives himself or herself in relation to peers, apart from family members and intimate friends. It is closely associated with the Physical section score. Clients may, at times, feel somewhat isolated from their peers. They may experience social awkwardness in some situations. They may avoid taking social risks and may sometimes have difficulty forming personal relationships. They may have somewhat unrealistic expectations about how social relationships should unfold.

Discussion of Results

This study compared aerobic exercise and the effects of memory tests of cognitive functioning and self concept evaluation. The findings of this analyses will be discussed to clarify results. This study will also be interpreted with respect to previous studies in order to identify similarities and differences to the existing body of knowledge, formulate ideas for further research in this field, and to suggest provisions for future systematic programs.

Repeated measures analyses of variance (ANOVAs) were utilized in this study to compare aerobic exercise on three cognitive functioning tests, and one psychological test. Of the twenty ANOVAs, four from the psychological test Stroop Interference Color/Word, Word Recall Memory, Response Distribution, and Social) resulted in significanct difference ($P< 0.05$) in time within the groups from pre-test to post-test and is considered to result from a learning effect.

The t-tests for paired samples indicated significant fitness differences from pre-test and post-test data in the laps/mile and the minutes/mile among the experimental group. No significant changes were found in the blood pressure measures.

The current study was conducted in an attempt to contribute to the existing body of knowledge of an aerobic exercise program on psychological well-being and cognitive functioning in a group of diverse community-residing older adults. The psychological test battery included a fifteen part self-concept test, the Tennessee Self-concept Scale #2. It was of interest to determine whether a positive relationship between aerobic exercise would effect perceptions of self-efficacy. Emery & Gatz (1990) examined the effects of a 12 - week aerobic exercise program on psychological well-being and cognitive functioning in a group of ethnically diverse older adults living in an urban community and indicated little change in psychological well-being and provided limited support for the association of physiological improvement with enhanced mastery and cognitive functioning, however they did indicate that exercise may benefit mood. The cognitive battery included common indicators of neuropsychological functioning in order to assess the capacity to integrate new information, skills that are largely independent of acquired knowledge, experience, and learning.

The present study's results parallel previous findings reported by Hill, Storandt, & Malley (1993), as their study was unable to document a relationship between improved cognitive function on selected neuropscychological measures and exercise training in an older adult sample. However, they did find improvement in cardiovascular fitness and a positive change in self-reported morale, along with significant effects noted from the Wechsler Memory Scale logical memory subtest.

Caution should be used when comparing the current results with those of previous studies due to differences that could reflect a genetic predisposition in the exercisers. It is conceived that individuals with above-average perceptual-motor and cognitive

abilities choose to lead more active lives than individuals with average abilities. Comparison of the fitness levels reported for the post exercise groups in the longitudinal studies and those reported for the lifetime exercisers clearly suggests that high levels of fitness are achieved after years rather than months of training.(Hawkins, Kramer, & Capaldi, 1992).

Comparing research studies designed to measure the effects of aerobic exercise with the current study addresses inherent differences. The differences between the previous studies and the current study include: statistical analyses, number of participants, length of time, medications, illness, and post-test, and pre-test status of subjects. Despite these differences, however, there are some similarities between the previous studies and the current study. Emery & Gatz, (1990) examined the effects of a 12-week aerobic exercise program on psychological well-being and cognitive functioning. Emery & Blumenthal, (1990) indicated that subject's perceived improvement in physical functioning was more closely related to objective indicators than perceived improvement in cognitive functioning and psychological well-being. One possible interpretation for this observation is that the standard measures of cognitive functioning and psychological well-being employed may not have been sensitive to the kinds of benefits that subjects derived from the physical exercise.

The present results indicated no significant changes in the psychological and cognitive functioning of the older adults; however, the exercise group did reap qualitative benefits of an aerobic exercise program. The present study also confirms that of other studies, that the participants did benefit from the exercise program, not from the quantitative aspect but benefits that cannot be measured. When volunteer subjects have never been involved

in an aerobic exercise program they cannot foresee any benefits that could occur through their participation in such a program. Participants acknowledged many benefits not associated with the psychomotor tests. During the exercise program participants expressed greater body strength, better sleeping habits, better joint movement without pain, and improved self confidence. Because of their involvement, the subjects are beginning to do many of the activities that they had previously given up. They were now carrying their groceries rather than using a cart. Many were moving faster with more asssurance and with less fatigue. They have become more involved with events, and activities and are making choices without the intervention of family or friends. One participant was able to maintain her balance after tripping over the wheel on her vacuum cleaner, and related that to having stronger muscles and muscles that were able to respond to the unfortunate incident.

The subjects had not previously participated in an aerobic exercise program, and their experience has resulted in their recognizing the value of the program. It may be assumed that these results are a direct affect of the participants involvement in an aerobic exercise program. Future studies would benefit greatly if questions relating to past abilities and present daily activities were addressed with participants prior to the beginning of the exercise program and measurements could be obtained that could determine just how effective an aerobic exercise program would be to the aging adult.

CHAPTER V

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER STUDY

The purpose of this study was to determine the effects of aerobic exercise training on psychological and cognitive function. Thirty-two sedentary older adults ranging in age from 70 - 93 were assigned to one of three groups: aerobic exercise training, social activity, or a non-active control group. Groups were tested on three cognitive functioning tests, Stroop Interference Test, Word Recall Memory Test, Simon Says and one self concept test, Tennessee Self-Concept Test #2. Data were collected on each subject at pre-test, mid-test (6 weeks) and post-test (12 weeks) .

Summary of Findings

The present study was designed to corroborate upon past research in this area by investigating the effects of a 12 - week aerobic exercise program on measures of cognitive functioning and psychological self concept among independent community-dwelling aging adults.

Hypothesis 1

There will be no significant differences in the participants response to the Stroop Interference Test, between the pre-test, mid-test, and post-test following a 12 week aerobic exercise program. The null hypothesis was accepted.

Hypothesis 2

There will be no significant differences in the participants response to the word recall memory test between the pre-test, mid-test, and post-test following a 12 week exercise program. The null hypothesis was accepted.

Hypothesis 3

There will be no significant differences in the participants response to the Simon Says memory game between the pre-test, mid-test, and post-test following a 12 week aerobic exercise program. The null hypothesis was accepted.

Hypothesis 4

There will be no significant differences in the participants response to the self-concept test between the pre-test, mid-test, and post-test following a 12 week aerobic exercise program. The null hypothesis was accepted.

Conclusions

It was hypothesized that participants in aerobic exercise would experience greater subjective gains than participants in the control conditions, and that subjective changes would be correlated with objective changes perceived no significant changes. Based on the results of this study it can be concluded that older adults participating in 12 week aerobic exercise perceived significant improvements in a number of areas of their lives not assessed by standardized psychometric tests.

Subjects commented on changes in sleep patterns, leg cramps, breathing patterns, and physical endurance. In the past, a 78 year old female in the experimental group experienced depression during the winter months resorting to medication. This was the first time in many years she did not depend on medication or experience depression. Another participating 89 year old, gained confidence in her ability to get around and she no longer needs the assistance of the guard rail in her apartment complex. Her family has commented on her being a different woman, one that can keep up when going shopping and other places. All subjects of the aerobic exercise group commented on improvements in their ability to maintain balance, lift heavier grocery bags, get up from sitting positions, climb stairs (muscular strength) and experienced a feeling of companionship with the group, making new friends and enjoying each other's company (loneliness). The group bonded together forming the name Gee, Gees (gorgeous gals) and recently participated in a local 2 mile walk, the Redbud Classic, in which all members completed the race. These subjective improvements extended not only to physical fitness and well-being, but also to areas of functioning not directly related to exercise or fitness suggests that improvements are ongoing and beneficial with regards to aerobic exercise.

Recommendations

Although the experimental hypotheses were not supported, this study provides both empirical and practical data regarding exercise programs for older adults. As society experiences an influx of older individuals, future research may benefit from concerns confronted in this study. These recommendations include: (1) changes involving a larger sample of subjects. By using more subjects, the power of the statistical analysists may yield a more sensitive analysis of the data; (2) to maximize the cardiorespiratory benefits of the exercise program, the exercise prescription could be more individualized,

based on treadmills, bicycle ergometry tests, etc; (3) the dependent variables could be expanded to include other dimensions relevant to the health and well-being of independent aging adults and include measures of assessed activities of daily living (ADL). (4) To find standard measures of cognitive functioning and psychological well-being that may be more sensitive to the kinds of benefits that subjects derived from the physical exercise. (5) ADL lifestyles that addresses the anecdotal information volunteered by the participants. Further studies of programs, aerobic exercise, social interaction activities in the community would enable society to understand the short and long term value of exercise interventions in the aging adult.

REFERENCES

ACSM (1995). Guidelines for exercise testing and prescriptions. New York: Williams & Williams.

Backman, L. & Nilsson, L. (1985). Prerequisites for lack of age differences in memory performance. Experimental Aging Research, 11, 67-73.

Bagby, G., Sembrowich, W., & Gollnick, P. (1972). Myosin ATPase and fiber type composition from trained and untrained rat skeletal muscle. Journal of Applied Physiology, 223, 1415-17.

Baltes, P. & Smith, J. (1990). The psychology of wisdom and its ontogenesis. In R. J. Sternberg (Ed.), Wisdom: Its nature, origins, and development (pp. 87-120). New York: Cambridge University Press.

Baltes, P. & Staudinger, U. (1993). The search for a psychology of wisdom. Current Directions in Psychological Science, 2, 75-80.

Baltes, P. (1991). The many faces of human aging: Toward a psychological culture of old age. Psychological Medicine, 21, 837-854.

Baltes, P. & Baltes, M. (1990). Psychological perspectives on successful aging: The model of selective optimization with compensation. In P. Baltes & M. Baltes (Eds.), Successful aging: Perspectives from the behavioral sciences (pp. 1-34). New York: Cambridge University Press.

Baltes, M. & Baltes, P.B. (1986). The psychology of control and aging. Hillsdale, NJ: Erlbaum.

Bandura, A. (1986). Social foundations of thought and action. Englewood Cliffs, NJ: Prentice Hall.

Barry, A. & Pruett, D. (1966). The effects of physical conditioning on older individuals: I. Work capacity, circulatory-respiratory function and work electrocardiogram. Journal of Gerentology, 21, 182-191.

Barry, A., Steinmetz, J.R., Page, H.E., & Rodahl, K. (1966). The effects of physical conditioning on older individuals. II. Motor performance and cognitive function. Journal of Gerontology, 21, 192-199.

Bengtson, V., Reedy, M.N.., & Gordon, C. (1985). Aging and self-conceptions: Personality processes and social contexts. In J. E. Birren & K. W. Schaie (Eds.), Handbook of the psychology of aging (2nd ed.) (pp. 544-593). New York: Van Nostrand Reinhold.

Birren, J. E. & Botwinick, J. (1951). The relation of writing speed to age and to the senile psychoses. Journal of Consulting Psychology, 15, 243-249.

Black, R. (1991). Muscle strength as an indicator of the habitual level of physical activity. Medicine and Science in Sports and Exercise, 23, 1375-81.

Blair, S.N., Kohl, H.W., III, Barlow, C.E., Paffenbarger, R.S., Gibbons, L.W., & Macera, C.A. (1995). Changes in physical fitness and all-cause mortality: A prospective study of healthy and unhealthy men. Journal of the American Medical Association, 273, 1093-1098.

Blumenthal, J. A., Emery, C.F., Madden, D.J., George, L. K., Coleman, R.E., Riddle, M.W., McKee, D.C., Reasoner, J., & Williams, R.S. (1989). Cardiovascular and behavioral effects of aerobic exercise training in healthy older men and women. Journal of Gerontology, 44, 147-157.

Blumenthal, J.A., Schocken, D., Needels, T., & Hindle, P. (1982). Psychological and physiological effects of physical conditioning on the elderly. Journal of Psychosomatic Research, 26, 505-510.

Bradburn, N.M. (1969). The structure of psychological well-being. Chicago: Aldine.

Brandstadter, J., & Greve, (1994). The aging self: Stabilizing and protective processes. Developmental Review.

Brim, G. (1992). Losing and winning: Ambition in everyday life. New York: Basic Books.

Buzan, T. (1994). Book of Genius. New York: Random House.

Cattell, R.B. (1963). Theory of fluid and crystallized intelligence: A critical experiment. Journal of Educational Psychology, 54, 1-22.

Chodzko-Zajko, W.J. (1991). Physical fitness, cognitive performance, and aging. Medicine and Science in Sports and Exercise, 23, 868-872.

Chow, R., Harrison, JE, & Notarius, C. (1987). Effect of two randomized exercise programs on bone mass of healthy post-menopausal women. Br Medical Journal, 295, 1441-1444.

Cohen, R.L., Peterson, M., & Mantini-Atkinson, T. (1987). Intervent differences in event memory: Why are some events more recallable than others? Memory & Cognition, 15, 109-118.

Cooper, KH. (1977). The Aerobics Way. New York: Evans & Company, 280-281.

Craik, F.I.M. (1977). Age differences in human memory. In J. Birren & K. Schaie (Eds.), Handbook of the psychology of aging (pp. 191-211). New York: Van Nostrand Reinhold.

Cross, S., & Markus, H. (1991). Possible selves across the lifespan. Human Development, 34, 230-255.

Cunningham, D.A., Rechnitzer, P.A., Howard, J.H., & Donner, A.P. (1987). Exercise training of men at retirement: A clinical trial. Journal of Gerontology, 42, 17-23.

deVries, H.A. (1970). Physiological effects of an exercise training regimen upon men aged 52-88. Journal of Gerontology, 25, 325-336.

deVries, H.A. (1975). Physiology of exercise and aging. In: Aging, edited by D. s. Woodruff and J. E. Birren. (pp. 257-276). New York: Van Nostrand.

Dittman-Kohli, F., & Baltes, P.B. (1990). Toward a neofunctionalist conception of adult intellectual development: Wisdom as a prototypical case of intellectual growth. In C. Alexander & E. Langer (Eds.), Higher stages of human development: Perspectives on adult growth (pp. 54-78). New York: Oxford University Press.

Dittmann-Kohli, F. (1992). Das personliche Sinnsystem. Ein Vergleich zwischen fruhem und spatem Erwachsenenalter [The personal system of sense of life: A comparison between early and last adulthood]. Unpublished habilitation, Free University, Berlin, Germany.

Dustman, R.E., Ruhling, R.O., Russell, E.M., Shearer, D.E., Bonekat, H.W., Shigeoka, J.W., Wood, J.S., & Bradford, D.C. (1984). Aerobic exercise training and improved neuropsychological function of older individuals. Neuro-biology of Aging, 5, 35-42.

Dustman, R.E., Emmerson, R.Y., Ruhling, R.O., Shearer, D.E., Steinhaus, L.A., Johnson, S.C., Bonekat, H.W., & Shigeoka, J.W. (1990). Age and fitness effects on EEG, ERPs, visual, sensitivity, and cognition. Neurobiology of Aging, 11, 193-200.

Elsayed, M., Ismail, A.H., & Young, R. (1980). Intellectual differences of adult men related to age and physical fitness before and after an exercise program. Journal of Gerontology, 35 (2), 383-387.

Emery, C.F., & Gatz, M. (1990). Psychological and cognitive effects of an exercise program for community-residing older adults. The Gerentologists Society of America, 184-188.

Emery, C.F., & Blumenthal, J.A. (1990). Perceived change among participants in an exercise program for older adults. The Gerontological Society of America, 516-521.

Fiatarone, M.A., O'Neill, E.F., Ryan, N.D. (1994). Exercise training and nutritional supplementation for physical frailty in very elderly people. N Engl J Med, 330, 1769-1775.

Filipp, S.H., & Klauer, T. (1986). Conceptions of self over the life span: Reflections on the dialectics of change. In M. M. Baltes & P. B. Baltes (Eds.), The psychology of control and aging (pp. 167-205). Hilldale, NJ: Erlbaum.

Fontane, P.E. (1996). Exercise, fitness, and feeling well. American Behavioral Scientist, 39 (3), 288-305.

Fries, J.F., Gurkirpal, S., Morfeld, D., Hubert, H.B., Lane, N.E., & Brown, B.W., Jr. (1994). Running and the development of disability with age. Annals of Internal Medicine, 121, 502-509.

Gitlin, L.N., Lawton, M.P., Windsor-Landsberg, L.A., Kleban, M.H., Sands, L.P., & Posner, J. (1992). In search of psychological benefits: Exercise in healthy older adults. Journal of Aging and Health, 4, 74-192.

Gollnick, P., & Saltin, B. (1983). Hypothes: Significance of skeletal muscle oxidative capacity with endurance training. Clinical Physiology, 2, 1-12.

Grembowski, D., Patrick, D., Diehr, P., Durham, M., Beresford, S., Kay, E., & Hecht, J. (1993). Self-efficacy and health behavior among older adults. Journal of Health and Social Behavior, 34, 89-104.

Hasher, L., & Zacks, R.T. (1979). Automatic and effortful processes in memory. Journal of Experimental Psychology: General, 108, 356-388.

Hasher, L., & Zacks, R.T. (1988). Working memory, comprehension, and aging: a review and a new view. The Psychology of Learning and Motivation, 22, 193-225.

Hawkins, H.L., Kramer, A.F., & Capaldi, D. (1992). Aging, exercise, and attention. Psychology and Aging, 7 (4), 643-653.

Hebb, D.O. (1949). The Organization of Behavior. New York: Wiley.

Heckhausen, J., Dixon, R.A., & Baltes, P.B. (1989). Gains and losses in development throughout adulthood as perceived by different adult age groups. Developmental Psychology, 25, 109-121.

Heckhausen, J., & Krueger, J. (1993). Developmental expectations for the self and most other people: Age-grading in three functions of social comparison. Development Psychology, 29, 539-548.

Heckhausen, J., & Schulz, R. (1993). Optimization by selection and compensation: Balancing primary and secondary control in life-span development. International Journal of Behavioral Development, 16, 287-303.

Hill, R.D., Storandt, M., & Malley, M. (1993). The impact of long-term exercise training on psychological function in older adults. Journal of Gerontology, 48P, 12-17.

Holloszy, J. (1983). Exercise, health, and aging: A need for more information. Medicine and Science in Sports and Exercise, 15, 1-5.

Hunt, C. (1991). Mammalian muscle spindle: Peripheral mechanisms. Physiological Reviews, 65, 468-540.

Ingebretsen, R. (1982). The relationship between physical activity and mental factors in the elderly. Scand Journal of Social Medicine, 29, 153-159.

Kannel, W., Belanger, A., D'Agostino, R., & Israel, I. (1986). Physical activity and physical demand on the job and risk of cardiovascular disease and death: The Framingham study. American Heart Journal, 112, 820-825.

Kausler, D.H., & Lichty, W. (1988). Memory for activities: Rehearsal-independence and aging. In M.L. Howe & C.J. Brainerd (Eds.), Cognitive development in adulthood (pp. 93-132). New York: Springer-Veriag.

Kavanaugh, T., & Shephard, R.J. (1978). The effects of continued training on the aging process. Annals of the New York Academy of Sciences, 301, 656-670.

Kiyohito, 0., Kozo, M., Tomoko, Wada, Shigeaki, K., Yoshinori, D., & Toshio, O. (1996). Effects of exercise on neurobehavioral function in community-dwelling older people more than 75 years of age. Journal of the American Geriatrics Society, 44, 569-572.

King, A.C., Taylor, B.C., & Haskell, W.L. (1993). Effects of differing intensities and formats of 12 months of exercise training on psychological outcomes in older adults. Health Psychology, 12, 292-300.

Kleigl, R., & Baltes, P.B. (1987). Theory-guided analysis of mechanisms of development and aging mechansims through testing-the-limits and research on expertise 1. In C. Schooler & K.W. Schaie (Eds.), Cognitive function and social structure over the life course (pp. 95-119). Norwood, NJ: Ablex.

Korteling, J. (1991). Effects of skill integration and perceptual competition on age-related differences in dual-task performance. Human Factors, 33, 35-44.

Kramer, A., Larish, J., & Strayer, D.L. (1995). "Training for attentional control in dual-task settings: A comparison of young and old adults, Journal of Experimental Psychology: Applied, 1, 50-76.

Lachman, M.E. (1986). Personal control in later life: Stability, change, and cognitive correlates. In M. M. Baltes & P. B. Baltes (Eds.), The psychology of control and aging (pp. 207-236). Hillsdale, NJ: Erlbaum.

Lau, R.R., & Ware, J.F. (1981). Refinements in the measure of health-specific locus-of-control beliefs. Medical Care, 19, 1147-1158.

Libow, L.S. (1974). Interaction of medicine, biologic and behavioral factors on aging, adaptation, and survival. An 11 year longitudinal study. Geriatrics, 29, 75-88.

Madden, D.J., Blumenthal, J.A., Allen, P.A., & Emery, C.F. (1989). Improving aerobic capacity in healthy older adults does not necessarily lead to improved cognitive performance. Psychology and Aging, 4, 307-320.

Markus, H.R., & Hertzog, A.R. (1991). The role of the self-concept in aging. Annual Review of Gerontology and Geriatrics, 11, 110-143.

Markus, H.R., & Wurf, E. (1987). The dynamic self-concept: A social psychological perspective, Annual Review of Psychology, 38, 299-337.

Maroulakis, E., & Zervas, Y. (1993). Effects of aerobic exercise on mood of adult women. Perceptual and Motor Skills, 76, 795-801.

McAuley, E. (1993). Self-efficacy, physical activity, and aging. In J. R. Kelly (Ed.), Activity and aging: Staying involved in later years. Newbury Park, CA: Sage.

McDowd, J., Vercruyssen, M., & Birren, J. (1991). Aging, divided attention, and dual-task performance. In D. Damos (Ed.), Multiple Task Performance (pp. 387-414). Bristol, PA: Taylor & Francis.

Metz, Y., Tanebaum, G., & Sagiv, M. (1988). Patterns of psychological fitness as related to patterns of physiological fitness among older adults. Perceptual and Motor Skills, 67, 647-655.

Molloy, D.W., Beerschoten, D.A., Borrie, M.J., Crilly, R.G., & Cape, R.D. T. (1988). Acute effects of exercise on neuropsychological function in elderly subjects. Journal of the American Geriatrics Society, 35, 29-33.

Ory, M.G., & Cox, D.M. (1994). Forging ahead: Linking health and behavior to improve quality of life in older people. Social Indicators Research, 33, 89-120.

Paffenbarger, R.S., & Hyde, R.T. (1987). Exercise and the aging process. In R. J. Carlson & B. Newman (Eds.), Issues and Trends in Health (pp. 242-253). St. Louis: C. V. Mosby.

Pearlin, L.I., & Schooler, C. (1978). The structure of coping. Journal of Health and Social Behavior, 19, 2-21.

Pekkanen, J., Marti, B., Nissinen, A. (1987). Reduction of premature mortality by high physical activity: A 20-year follow-up of middle-aged Finnish men. Lancet, 1, 1473-1477.

Perri, S., & Templer, D.I. (1985). The effects of an aerobic exercise program on psychological variables in older adults. International Journal of Aging and Human Development, 20, 167-172.

Public Health Service. (1993a). Public health focus: Physical activity and the prevention of coronary heart disease. MMWR?Morbidity and Mortality Weekly Report, 42, 668-672.

Public Health Service, National Center for Health Statistics. (1994). Health: United States, 1993 (DHHS Publication No. PHS-94-1232). Hyattsville, MD: U.S. Government Printing Office.

Radloff, L. (1977). The CES-D scale: A self-report depression scale for research in the general population. Applied Psychological Measurement, 1, 385-401.

Rakowski, W., & Mor, V. (1992). The association of physical activity with mortality among older adults in the longitudinal study of aging (1984-1988). Journal of Gerontology: Medical Sciences, 47, M122-M129.

Ramotar, J.E. (1993). Activity deters heart disease, stroke (news briefs). The Physician and Sportsmedicine, 21, 14-15.

Reitan, R.M. (1958). Validity of the trail making test as an indicator of organic brain damage. Perceptual and Motor Skills, 8, 271-276.

Rosenstock, I.M. (1974). Historical origins of the health belief model. Health Education Monographs, 2, 328-335.

Rotter, J.B. (1966). Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs, 80, 1Whole No. 609.

Ryff, C.D. (1991). Possible selves in adulthood and old age: A tale of shifting horizons. Psychology and Aging, 6, 286-295.

Saltin, B., Hartley, H., Kilborn, A., & Astrand, I. (1969). Physical training in sedentary middle-aged and older men. II. Scandinavian Journal of Clinical and Laboratory Investigation, 24, 323-334.

Salthouse, T.A. (1991). Theoretical Perspectives on Cognitive Aging. Hillsdale, NJ: Erlbaum.

Schwab, M., Rader, J., & Doan, J. (1985). Relieving the anxiety and fear in dementia. Journal of Gerontological Nursing, 11, 8-15.

Seiler, S. (1996). Maximal oxygen consumption - the V02 max.

Shepherd, RJ. (1990). The scientific basis of exercise prescribing for the very old. Journal of Geriatric Society, 38, 62-70.

Sidney, K.H., Shephard, RJ, Harrison, J. (1977). Endurance training and body composition of the elderly. American Journal of Clinical Nurtrition, 30, 326-333.

Smith, J., Dixon, R.A., & Baltes, P.B. (1989). Experitse in life-planning: A ne research approach to investigating aspects of wisdom. In M. L. Commons, J. D. Sinnott, F. A. Richards, & C. Armon (Eds.), Adult development: Comparisons and applications of developmental models, 1, 307-331. New York: Plaeger.

Sokoloff, L. (1966). Cerebral circulation and metabolic changes associated with aging. Research Publication of the Association for Respiratory. Nervous and Mental Diseases, 42, 237-254.

Sokoloff, L. (1976). Cerebral ciruclation and metabolism in the aged. Psycholpharmacology Bulletin, 11, 45-46.

Spirduso, W.W., & Asplund, L.A. (1995). Physical activity and cognitive function in the elderly. American Academy of Kinesiology and Physical Education, 47, 395-410.

Spirduso, W.W. (1980). Physical fitness, aging, and psychomotor speed: A review. Journal of Gerontology, 35, 850-865.

Staudinger, U.M. (1989). The study of life review: An approach to the investigation of intellectual development across the life span. Berlin: Edition Sigma.

Steinhaus, L.A., Dustman, R.E., Ruhling, R.O., Emmerson, R.Y., Johnson, S.C., Shearer, D.E., Latin, R.W., Shigeoka, J.W., & Bonekat, W.H. (1990). Aerobic capacity of older adults: a training study. The Journal of Sports Medicine and Physical Fitness, 30, 163-172.

Stewart, A.L., King, A.C., & Haskell, W.L. (1993). Endurance exercise and health-related quality of life in 50-65 year-old adults. The Gerontologist, 33 (6), 782-789.

Stones, M.J., & Dawe, D. (1993). Acute exercise facilitates semantically cued memory in nursing home residents. Journal of the American Geriatrics Society, 41, 531-534.

Taylor, S.E., & Lobel, M. (1989). Social comparison activity under threat: Downward evaluation and upward contacts. Psychological Bulletin, 96, 569-575.

Tipton, C.H. (1984). Exercise, training and hypertension. Exercise Sport Science Review, 12, 245-306.

Weschsler, D. (1981). WAIS-R manual. New York: Harcourt Brace.

Whitbourne, S.K. (1985). The psychological construction of the life span. In J. E. Birren & K. W. Schaie (Eds.), Handbook of the psychology of aging (2nd ed.), (pp. 594-618). New York: Van Nostrand Reinhold.

Wood, J.V. (1989). Theory and research concerning social comparisons of personal attributes. Psychological Bulletin, 106, 231-248.

APPENDIXES

APPENDIX A

INDIVIDUAL'S CONSENT FOR

PARTICIPATION IN A

RESEARCH PROJECT

Individual's Consent Form For Participation in a Research Study
Oklahoma State University

I, _____, voluntarily agree to participate in this study entitled: Effects of Aerobic Exercise Training and Cognitive Functioning in Aging Adults.

1.) **PURPOSE**: This study involves research that will be conducted under the supervision of Bert H. Jacobson, Ed. D. (principal investigator) and Pat Querry, Graduate Student. The intent of this study will be to ascertain the effects of aerobic exercise training on three areas of cognitive functioning by administering three cognitive tests: Word Test Recall, Simon Says, Stroop, and The Adult Tennessee Self-Concept test to evaluate self-concept.

2.) **STATUS OF INVESTIGATING PROCEDURES:** Aerobic exercise may alter blood pressure, heart rate, and oxygen saturation levels.

3.) **DESCRIPTION OF STUDY:** This study will involve a pre-screening determining non-exercising individuals and homogeneity of subjects. A medical release consent form will be required of all study participants. These subjects will be divided into three groups: a control group, control interaction and an experimental group. The control group and control interaction group will participate in the Word Test Recall, Simon Says, Stroop and The Adult Tennessee Self-Concept tests at pre-mid-and post-test periods. The assistant investigtor will meet once a week with the control/interaction, but will have no further intervention with the control group. The experimental group will participate in the Rockport Fitness Walking program for 12 weeks, 3 times a week for approximately one (1) hour per session. They will also participate in the Word Recall Test, Simon Says, Stroop and Self-Concept tests at pre-mid and post-tests periods.

The full duration of this study will be 12 weeks and will take approximately one (1) hour, 3 times a week.

I understand that I will participate in aerobic exercise training sessions (experimental group) or will be part of the control group or control/ interaction group that will only participate in the cognitive/self-concept pre-mid- and post-test periods.

4.) **BENEFITS:** Experimental group may lead to observable changes in physical appearance, attitude, and a greater awareness of their physical potential. Control group may find attitudinal changes due to participation in helping with research.

5.) **POSSIBLE RISKS:** Respiration, blood pressure, heart rate and oxygen saturation levels may increase as a result of aerobic exercise training. The graduate student, Pat Querry, conducting the exercise program has the training to provide CPR and first aid training (if necessary) to any participant needing assistance. A phone will be available to call 911 for emergency back-up assistance.

If I feel ill, or experience any side effects, I will report them immediately to the investigator, my physician or his/her associates. If these ill effects remain, I may be removed from the study.

6.) **ALTERNATIVE PROCEDURES:** None

7.) **SUBJECT ASSURANCES:** Whereas no assurance can be made concerning results that my be obtained (because results from investigating studies cannot be predicted with certainty), the principal investigator, will take every precaution consistent with best scientific practice.

If I have any further questions of concerns in regards to this study, I may contact Gay Clarkson at Oklahoma State University for additional information.

I may revoke my consent and withdraw from this study at any time without penalty or loss of benefits. My treatment by, and relations with the investigators and staff at Oklahoma State University, now and in the future, will not be affected in any way if I refuse to participate, or if I enter the program and later withdraw.

Records of this study will be kept confidential with respect to any written or verbal reports making it impossible to identify me individually. All records will be held in a locked file belonging to the principal investigator.

If I have any questions about my rights as a research subject, I may take them to the Office of University Research Services, 001 Life Sciences East. Phone: 744-5700.

8.) **SIGNATURES:**

Date _____Research Subject

_____

Date _____Witness

_____

Date _____ Principal Investigator

_____

Any questions regarding the research may be addressed to Bert Jacobson, Principal Investigator. 102 Colvin Center. Phone: 744-5493.

Subjects will receive a copy of this consent form following the investigation.

APPENDIX B

AEROBIC EXERCISE

RESEARCH QUESTIONNAIRE

SCREEN TEST

NAME:
AGE :_____ GENDER M F

1) ARE YOU ? MARRIED WIDOW
WIDOWER
SINGLE OTHER

2) DO YOU LIVE ALONE? YES NO

3) WHAT IS YOUR OVERALL SELF-REPORTED HEALTH STATUS?

EXCELLENT
VERY-GOOD
GOOD
FAIR
POOR

4) WHAT IS YOUR PRESENT HEALTH COMPARED WITH YOUR HEALTH ONE YEAR AGO?

MUCH BETTER
BETTER
SAME
WORSE
MUCH WORSE

5) HOW OFTEN DID YOU SEE A PHYSICIAN IN THE PAST YEAR?

NONE 1-2 TIMES 3-4 TIMES 5+

6) HOW MANY DAYS WERE YOU RESTRICTED TO BED DURING THE PAST 6 MONTHS?

NONE 1-5 DAYS 6-9 DAYS 10+

7) HOW MANY PRESCRIPTION MEDICATIONS DO YOU TAKE?

NONE 1 2 3 MORE

8) WHAT KIND (S) OF PRESCRIPTION MEDICATIONS DO YOU TAKE AND HOW OFTEN DO YOU TAKE THEM?

9) HOW MANY OVER-THE-COUNTER DRUGS DO

YOU TAKE?

NONE 1 2 3 MORE

10) WHAT KIND (S) OF OVER-THE-COUNTER DRUGS DO YOU TAKE AND HOW OFTEN DO YOU TAKE THEM?

11) DO YOU HAVE A BONE OR JOINT PROBLEM THAT COULD BE MADE WORSE BY A CHANGE IN YOUR PHYSICAL ACTIVITY?

YES NO

12) HOW OFTEN DO YOU ENGAGE IN PHYSICAL ACTIVITY?

NONE DAY WEEK MONTH

IF SO, WHAT KIND?

13) DO YOU WALK FOR A PERIOD OF 10 MINUTES OR LONGER?

NONE DAILY WEEKLY MONTHLY

14) WHEN WAS THE LAST TIME YOU WERE INVOLVED IN AN EXERCISE PROGRAM?

6MOS. 1-YEAR 2-YEARS 3-YEARS

15) WERE YOU AN ATHLETE IN YOUR EARLIER YEARS?

NO YES WHEN WHAT

16) DO YOU KNOW OF ANY REASON WHY YOU SHOULD NOT DO PHYSICAL ACTIVITY?

YES NO

17) HOW MANY TIMES A WEEK DO YOU PARTICIPATE IN SOCIAL ACTIVITIES?

1-DAY 2-DAYS 3+DAYS

18) HOW OFTEN DO YOU SPEND TIME WITH YOUR EXTENDED FAMILY?

ONCE A WEEK
TWICE A WEEK
MORE
LESS

19) WHAT IS YOUR FAVORITE PASTTIME?

20) WHAT WAS YOUR LAST YEAR OF EDUCATION?

HIGH SCHOOL
COLLEGE
OTHER ;

I HAVE READ, UNDERSTOOD AND COMPLETED THIS QUESTIONNAIRE/

ANY QUESTIONS I HAD WERE ANSWERED TO MY FULL SATISFACTION.

NAME _____

SIGNATURE _____

DATE_____

WITNESS _____

APPENDIX C

WORD RECALL AND "SIMON SAYS"

RESPONSE SHEETS

WORD TEST RECALL

SUBJECTS WILL BE ADMINISTERED THE WORD RECALL TEST BY REPEATING THE WORDS, OR SERIES OF WORDS.

EACH WORD, OR SERIES OF WORDS WILL BE READ TO SUBJECTS AT 1 SECOND INTERVALS, WITH THE SUBJECT REPEATING THE WORDS BACK IN THE SAME SEQUENTIAL FASHION.

SUBJECT WILL BEGIN REPEATING THE WORDS AFTER THE INVESTIGATOR FINISHES THE WORD WITH AND, THAT IS THE SUBJECTS CLUE TO RESPOND.

SCORES WILL BE DETERMINED BY THE PRE-TEST, MID-TEST, AND POST-TEST, WITH THE SUBJECTS SCORE BEING DETERMINED BY THE LAST WORD REPEATED CORRECTLY.

EXAMPLE: 1) tree, and
2) rake, mouse, glove, and

1) plate, and

2) shovel, and

3) glass, and

4) school, socks, and

5) sun, sweater, and

6) telephone, water, and

7) star, lock, friend, and

8) car, dishes, God, and

9) planet, clock, hair, and

10) hat, pan, astronaut, and

11) celery, carpet, truck, and

12) gold, book, frisbee, and

13) love, wall, boat, desk, and

14) pole, grass, chair bicycle, and

15) owl, tube, handle, lamp, and

16) barn, fish, bus, house, rock, and

17) cotton, oak, garage, cow, table, and

18) salt, linen, turtle, window, coffee, and

19) needle, lightning, food, shower, wood, ball, and

20) paper, cup, belt, sun, milk, bat, and

21) frame, bush, pen, lake, flower, fence, and

22) sink, tea, boy, church, kitten, month, kids, and

23) cork, lamb, corn, time, girl, toy, stick, and

24) camera, airplane, mom, beans, son, cat, teeth, and

25) room, light, horse, pray, marriage, pillow, fire, swim, and

26) dog, ladder, faith, sister, stove, kiss, shoe, night, and

27) face, picture, vehicle, nose, hamper, mop, mitten, tornado, and

SIMON "SAYS"
(SEQUENCE MEMORY RECALL)

1

2 3

4 5 6

7 8 9 10

11 12 13 14 15

16 17 18 19 20 21

22 23 24 25 26 27 28

29 30 31 32 33 34 35 36

37 38 39 40 41 42 43 44 45

46 47 48 49 50 51 52 53 54 55

APPENDIX D

RAW DATA RECORD SHEET

WORD TEST RECALL

	PRE-TEST	MID-TEST	POST-TEST
DATE:	_____	_____	_____
SCORE:	_____	_____	_____

SIMON SAYS

	PRE-TEST	MID-TEST	POST-TEST
DATE:	_____	_____	_____
SCORE:	_____	_____	_____

SELF-CONCEPT

	PRE-TEST	MID-TEST	POST-TEST
DATE:	_____	_____	_____
SCORE:	_____	_____	_____

STROOP TEST

	PRE-TEST (1) (2) (3)	MID-TEST (1) (2) (3)	POST-TEST (1) (2) (3)
DATE:	_____	_____	_____
SCORE:	____/____/____	____/____/____	____/____/____

APPENDIX E

ROCKPORT WALKING FITNESS TEST

ROCKPORT WALKING FITNESS TEST

LEVEL I WEEK	1-2	3-4	5-6	7	8-9	10-12	13	14	15-16	17-18	19-20
WARM-UP / COOL DOWN (stretches before and after walk in min.)	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7
MILEAGE	1.5	1.75	2.0	2.0	2.25	2.5	2.75	2.75	3.0	3.25	3.5
PACE (MPH)	3.0	3.0	3.0	3.5	3.5	3.5	3.5	4.0	4.0	4.0	4.0
HEART RATE (% OF MAX)	60-70	60-70	60-70	70	70	70	70	70-80	70-80	70-80	70-80
FREQUENCY (TIMES PER WEEK)	5	5	5	5	5	5	5	5	5	5	5

LEVEL II WEEK	1-2	3-4	5	6	7-8	9	10	11	12-13	14	15-16	17-18	19-20
WARM-UP / COOL DOWN (stretches before and after walk in min.)	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7
MILEAGE	1.0	1.25	1.5	1.5	1.75	2.0	2.0	2.0	2.25	2.5	2.5	2.75	3.0
PACE (MPH)	3.0	3.0	3.0	3.5	3.5	3.5	3.75	3.75	3.75	3.75	4.0	4.0	4.0
HEART RATE (% OF MAX)	60	60	60	60-70	60-70	60-70	60-70	70	70	70	70	70-80	70-80
FREQUENCY (TIMES PER WEEK)	5	5	5	5	5	5	5	5	5	5	5	5	5

LEVEL III WEEK	1	2	3-4	5	6-8	9-10	11-12	13-14	15	16-17	18-20	maintenance
WARM-UP / COOL DOWN (stretches before and after walk in min.)	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7
MILEAGE	2.0	2.25	2.5	2.75	2.75	3.0	3.0	3.25	3.5	3.5	4.0	4.0
[illegible]	3.0	3.0	3.0	3.0	3.5	3.5	4.0	4.0	4.0	4.5	4.5	4.5
HEART RATE (% OF MAX)	70	70	70	70	70	70	70-80	70-80	70-80	70-80	70-80	70-80
FREQUENCY (TIMES PER WEEK)	5	5	5	5	5	5	5	5	5	5	5	3-5

LEVEL IV WEEK	1	2	3-4	5	6	7	8	9-10	11-14	15-20	maintenance
WARM-UP / COOL DOWN (stretches before and after walk in min.)	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7
MILEAGE	2.5	2.75	3.0	3.25	3.5	3.5	3.75	4.0	4.0	4.0	4.0
PACE (MPH)	3.5	3.5	3.5	3.5	3.5	4.0	4.0	4.0	4.5	4.5	4.5
HEART RATE (% OF MAX)	70	70	70	70	70-80	70-80	70-80	70-80	70-80	70-80	70-80
FREQUENCY (TIMES PER WEEK)	5	5	5	5	5	5	5	5	5	5	3-5

LEVEL V WEEK	1	2	3	4	5	6	7-20	maintenance
WARM-UP / COOL DOWN (stretches before and after walk in min.)	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7
MILEAGE	3.0	3.25	3.5	3.5	3.75	4.0	4.0	4.0
PACE (MPH)	4.0	4.0	4.0	4.5	4.5	4.5	4.5	4.5
HEART RATE (% OF MAX)	70	70	70	70-80	70-80	70-80	70-80	70-80
FREQUENCY (TIMES PER WEEK)	5	5	5	5	5	5	5	3-5

APPENDIX F

OVERALL VIEW OF
STROOP INTERFERENCE TEST
WORD RECALL AND SIMON SAYS MEMORY TESTS
TENNESSEE SELF CONCEPT TEST #2

Table II

STROOP INTERFERENCE TEST

	Experimental Group			Control/Interaction Group			Control Group		
	Pre	Mid	Post	Pre	Mid	Post	Pre	Mid	Post
Word	45.8 ± 12.18	44.4 ± 11 34	48.5 ± 12.53	44.6 ± 6.80	42.8 ± 6.12	42.0 ± 5.73	44.5 ± 8.28	43.6 ± 7.52	43.5 ± 7.17
Color	42.9 ± 10.10	43.7 ± 10.64	45.8 ± 11.50	42.6 ± 8.94	41.0 ± 6.87	40.4 ± 6.44	40.5 ± 9.08	42.4 ± 8.98	40.9 ± 7.71
Color/Word	50.7 ± 12.68	52.3 ± 9.61	54.9 ± 10.21	44.8 ± 16.00	52.6 ± 12.18	50.2 ± 14.31	47.9 ± 11.97	49.2 ± 5.81	50.1 ± 8.79

TABLE III

WORD RECALL AND SIMON SAYS MEMORY TESTS

	Experimental Group			Control/Interaction Group			Control Group		
	Pre	Mid	Post	Pre	Mid	Post	Pre	Mid	Post
Word Recall Memory Test	3.7 ± 0.78	4.4 ± 0.67	5.2 ± 0.60	3.7 ± 0.67	4.4 ± 0.96	5.3 ± 0.82	3.9 ± 0.70	4.9 ± 0.83	5.0 ± 0.83
Simon Says Memory Test	5.6 ± 1.74	6.0 ± 1.44	6.2 ± 1.79	6.6 ± 1.51	6.2 ± 1.22	6.3 ± 0.67	6.2 ± 1.48	7.2 ± 1.10	6.9 ± 1.30

TABLE IV

TENNESSEE SELF-CONCEPT TEST

	Experimental Group			Control/Interaction Group			Control Group		
	Pre	Mid	Post	Pre	Mid	Post	Pre	Mid	Post
ACA	47.6 ± 11.28	46.2 ± 12.57	47.0 ± 12.07	46.1 ± 15.40	43.9 ± 10.00	47.2 ± 11.05	42.1 ± 8.89	47.5 ± 10.64	42.9 ± 9.43
BHV	51.2 ± 13.13	50.8 ± 11.16	55.5 ± 12.39	52.3 ± 12.95	46.2 ± 13.88	47.5 ± 8.93	50.1 ± 13.38	50.6 ± 9.79	52.3 ± 9.84
CON	59.3 ± 15.23	54.9 ± 17.56	56.5 ± 13.74	57.6 ± 10.73	55.2 ± 10.92	56.4 ± 10.13	58.7 ± 12.32	55.5 ± 11.65	50.8 ± 12.27
FAM	54.8 ± 11.12	52.4 ± 10.06	54.6 ± 10.68	50.5 ± 11.90	49.4 ± 11.21	46.1 ± 8.17	46.3 ± 11.45	50.2 ± 9.46	48.5 ± 12.86
FG	53.2 ± 8.54	54.8 ± 13.71	58.0 ± 9.84	47.3 ± 14.13	52.9 ± 13.59	49.3 ± 11.87	48.2 ± 10.26	45.6 ± 10.08	47.7 ± 7.08
IDN	52.4 ± 7.76	50.4 ± 12.25	52.1 ± 5.17	55.4 ± 16.66	51.2 ± 12.06	48.2 ± 10.99	49.1 ± 10.34	48.5 ± 7.44	46.6 ± 10.65
INC	57.7 ± 10.30	49.8 ± 12.06	57.3 ± 10.37	54.7 ± 9.31	56.5 ± 14.69	55.3 ± 16.72	61.3 ± 10.62	52.6 ± 8.47	49.0 ± 11.59
MOR	5 5.7 ± 9.40	51.8 ± 11.73	55.0 ± 7.73	52.7 ± 13.51	49.7 ± 12.97	48.6 ± 13.09	51.4 ± 14.05	54.4 ± 11.97	53.6 ± 10.96
PER	53.9 ± 9.26	49.7 ± 10.88	55.2 ± 6.73	49.6 ± 14.96	49.1 ± 10.93	46.6 ± 11.03	50.0 ± 13.90	47.6 ± 11.62	51.1 ± 8.97
PHY	51.2 ± 11.77	51.7 ± 10.19	53.9 ± 6.41	50.9 ± 11.35	48.7 ± 9.16	48.6 ± 10.30	48.7 ± 10.46	46.1 ± 7.33	47.0 ± 8.58
RD	54.1 ± 9.42	52.7 ± 9.40	55.1 ± 10.01	58.6 + 13.87	52.6 ± 13.00	50.1 ± 15.42	55.0 ± 11.54	47.9 ± 11.60	47.9 ± 10.11
SAT	46.2 ± 12.63	50.2 ± 8.98	47.4 ± 12.35	47.4 ± 12.75	47.0 ± 11.24	46.8 ± 9.69	48.1 ± 11.37	49.7 ± 9.05	50.3 ± 9.04
OC	50.9 ± 9.34	47.6 ± 9.46	48.4 ± 7.72	51.0 ± 9.22	46.0 ± 8.15	45.7 ± 9.11	52.6 ± 13.23	48.9 ± 10.94	50.5 ± 11.82
SC	38.0 ± 8.72	35.9 ± 7.43	38.2 ± 8.76	43.8 ± 11.84	42.2 ± 9.21	42.9 ± 7.80	48.0 ± 12.62	45.2 ± 8.50	46.5 ± 7.48
									48.4 ± 9.26

APPENDIX G

INTERNAL REVIEW BOARD (IRB)

REVIEW FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 09-16-97 **IRB#:** ED-98-011

Proposal Title: EFFECTS OF AEROBIC EXERCISE TRAINING AND COGNITIVE FUNCTIONING IN AGING ADULTS

Principal Investigator(s): Bert Jacobson, Pat Querry

Reviewed and Processed as: Expedited

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:

Signature: _____ Date: September 25, 1997
Chair of Institutional Review Board
cc: Pat Querry

2

VITA

Patricia Ann Querry

Candidate for the Degree of

Doctor of Education

Thesis: EFFECTS OF AEROBIC EXERCISE TRAINING AND COGNITIVE FUNCTIONING IN AGING ADULTS

Major Field: Applied Educational Studies

Minor Field: Health Promotion

Biographical:

Personal Data: Born in Danville, Illinois, August 10, 1949, the daughter William and Iris Wright.

Education: Graduated from Francesville High School, Francesville, In, May 1967; received Bachelor of Science degree in Health and Physical Education, Recreation, and Dance from the University of Central Oklahoma in 1988; received Master of Education in 1990, completed the requirements for the Doctor of Education degree at Oklahoma State University in May 1998.

Professional Experience: Instructor in the Department of Health and Sports Sciences, Oklahoma University, 1990-1992, Wrote Independent Study Curriculum/Program (Personal Health 2913), 1994, Instructor in the HPERD department, University of Central Oklahoma, 1992-present.

Professional Memberships: AAHPERD, OAHPERD.