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The effect of prescribed and preferred intensity exercise on the relationship between self-efficacy and perceived exertion in older adults

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**THE EFFECT OF PRESCRIBED AND PREFERRED INTENSITY
EXERCISE ON THE RELATIONSHIP BETWEEN SELF-EFFICACY
AND PERCEIVED EXERTION IN OLDER ADULTS**

By

Keith Robert Scotson

**A Thesis Submitted in Partial Fulfilment of the Requirements for the Award
of Master of Science (Sport Science)**

at the school of Biomedical and Sport Science, Edith Cowan University

Date of submission: 20 /11 / 2001

USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

Declaration

I certify that this thesis does not incorporate without acknowledgment, any material previously submitted for a degree or diploma in any institution of higher education, and that to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where due reference is made in the text. The Thesis does not contain any defamatory material.



Date.....20/11/01.....

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Abstract

This study was concerned with acute responses to exercise in people over the age of 50 ($N = 80$). In particular the relationship between Self-efficacy and perceived exertion during exercise at workloads (a) based on a target heart rate (prescribed intensities) and (b) based on participant preference (preferred intensities) were observed. Perceptual (perceived exertion), Self-efficacy and heart rate responses of low active older participants engaged in either walking or cycle ergometer exercise at preferred and prescribed intensities were also reported. Significant inverse correlations were observed between pre and post exercise Self-efficacy and perceived exertion during acute exercise at prescribed intensities ($p < .01$). In contrast no significant correlations were observed between these variables during acute preferred intensity exercise. These findings suggest that differences exist in the nature of the interaction between physiological and psychological responses to acute exercise at prescribed compared to preferred intensities. It was also found that low active participants experienced greater increases in pre to post exercise Self-efficacy ($p < .01$), and reduced levels of perceived exertion ($p < .01$), during acute exercise consisting of walking at preferred intensities compared to walking at prescribed intensities. Heart rate responses observed across time for participants engaged in walking at preferred intensities fell within a range of intensities suitable for improving aerobic conditioning. It is therefore concluded that exercise guidelines which encourage individuals to exercise at intensities they prefer represent a safe and effective alternative to traditional exercise prescriptions for guiding intensity when the primary aim is to reduce negative acute responses to exercise and maximise levels of Self-efficacy.

Table of Contents

	Page
Declaration	iii
Acknowledgments	iv
Abstract	v
List of Figures	ix
List of Tables	x
 CHAPTER	
 1. INTRODUCTION	1
Background	1
Research Questions	5
Significance of the Study	6
Limitations and Assumptions	7
Definition of Terms	8
 2. LITERATURE REVIEW	11
Introduction	11
Self-efficacy	15
Basis of Self-efficacy Theory	16
Self-efficacy, Thought and Action	17
Sources of Self-efficacy	18
Perceived Exertion	22
Physiological Determinants	23
Integration of Physiological Determinants	24
Psychological Determinants	25

Integration of Physiological and Psychological Determinants	26
Relationship between Self-efficacy and Perceived Exertion	28
Exercise at Prescribed Intensities	30
Physiological and Perceptual Responses	31
Exercise at Preferred Intensities	32
Physiological and Perceptual Responses	33
Safety Considerations	34
Summary and Conclusions	35
3. GENERAL METHODS	37
Recruitment and Participants	37
Assignment to Experimental Groups	39
Measures and Equipment	41
Self-efficacy	41
Perceived Exertion	42
Cycle Ergometer	43
Heart Rate	43
Skinfolds and Body Mass	44
Procedures	44
Prescribed Intensities	45
Preferred Intensities	45
Cycling	46
Walking	47
Statistical Analyses	47
Reliability	48
4. RESULTS	49
Relationship Between Self-efficacy and Perceived Exertion	49
Participant Characteristics	49
Exercise Responses	49

Relationship Between Pre exercise Self-efficacy and Perceived Exertion (PSC)	52
Relationship Between Perceived Exertion and Post Exercise Self-efficacy (PSC)	52
Relationship Between Pre exercise Self-efficacy and Perceived Exertion (PFC)	53
Relationship Between Perceived Exertion and Post Exercise Self-efficacy (PFC)	56
Relationship Between Pre exercise Self-efficacy and Perceived Exertion (PFW)	57
Relationship Between Perceived Exertion and Post Exercise Self-efficacy (PFW)	57
Perceived Exertion, Self-efficacy and Heart Rate Responses	59
Participant Characteristics	59
Perceived Exertion	60
Self-efficacy	61
Heart Rate Responses	62
5. DISCUSSION	65
Introduction	65
Relationships Between Self-efficacy and Perceived Exertion (Prescribed Intensities)	66
Relationships Between Self-efficacy and Perceived Exertion (Preferred Intensities)	69
Responses to Prescribed and Preferred Intensity Exercise (Low Active Individuals)	72
6. CONCLUSIONS AND RECOMMENDATIONS	76
REFERENCES	79

APPENDICES

92

A	National Physical Activity Guidelines	92
B	Health Risk Questionnaire	99
C	Activity Index Questionnaire	101
D	Self-efficacy Questionnaires	103
E	Borg Perceived Exertion Scale	108
F	Instructions for Estimating Perceived Exertion	110
G	Participant Handout / Written consent	112

List of Figures

Figure	Page
2.1 The relationship between the three major determinants of triadic reciprocal causation	19
2.2 Components of somatic interpretation	28
3.1 Distribution of Exercise Questionnaire Scores	39
4.1 Mean Workload across time for PSC, PFC, and PFW	51
4.2 Mean Heart rate across time for PSC, PFC, and PFW	51
4.3 Mean Perceived exertion across time for PSC, PFC, and PFW	54
4.4 Correlation between pre exercise Self-efficacy and perceived exertion (PSC)	54
4.5 Correlation between perceived exertion and post exercise Self-efficacy (PSC)	55
4.6 Correlation between pre exercise Self-efficacy and perceived exertion (PFC)	55
4.7 Correlation between perceived exertion and post exercise Self-efficacy (PFC)	58
4.8 Correlation between pre exercise Self-efficacy and perceived exertion (PFW)	58

4.9	Correlation between perceived exertion and post exercise Self-efficacy (PFW)	59
4.10	Perceived exertion across time for LPSC, LPFC, LPSW, and LPFW	64
4.11	Heart rate across time for LPSC, LPFC, LPSW, and LPFW	64

List of Tables

Table	Page
3.1 Participant Characteristics	41
4.1 Participant characteristics for PSC, PFC, and PFW	50
4.2 Intercorrelations between physiological and psychological responses (PSC)	53
4.3 Intercorrelations between physiological and psychological responses (PFC)	56
4.4 Intercorrelations between physiological and psychological responses (PFW)	57
4.5 Participant characteristics for LPSC, LPFC, LPSW, and LPFW	60
4.6 Exercise responses for LPSC, LPFC, LPSW, and LPFW	63

CHAPTER ONE

INTRODUCTION

Background

There is evidence that provides clear support for the positive influence exercise has on psychosocial and physical health (Shephard, 1995; Taylor, 1992). To this end the American College of Sports Medicine (A.C.S.M.) recommends that all adults should accumulate at least 30 minutes of moderate intensity activity on most days of the week (A.C.S.M., 2000) in order to maintain health and well being. While many older individuals understand and acknowledge the benefits of engaging regularly in activity (Owen & Lee, 1989; Smith & Storandt, 1997) and hold sincere intentions to pursue active lifestyles, people over 50 years of age are over represented in that section of the total population which does not engage in sufficient exercise on a regular basis (Daly & Spinks, 2000; Owen & Bauman, 1992). This lack of participation in that which has been identified as important for health may be attributed to a wide range of physiological and psychosocial barriers to exercise associated with aging.

Self-efficacy is defined as "people's beliefs about their capabilities to exercise control over events which affect their lives" (Bandura, 1989, p. 1175). Level of self-efficacy is an important influence on the degree of persistence displayed by individuals during early attempts to incorporate regular exercise into a healthy lifestyle (Deshaunais, Boullion & Godin, 1986; McAuley, 1991, 1993; McAuley & Jacobson, 1991; O'Brien Cousins, 1996). Therefore it appears that the facilitation of acute exercise experiences that optimise levels of

self-efficacy is an important factor in encouraging participation by older members of our population. However there is a paucity of existing research that has examined acute self-efficacy associated with single bouts of exercise in older adults.

It has been proposed that pre-existing level of self-efficacy is negatively correlated with the degree of physical strain (termed perceived exertion) experienced by an individual during the course of a bout of exercise (Rudolph & McAuley, 1996). In turn it has been reported that the level of perceived exertion experienced during exercise is negatively correlated with post exercise self-efficacy (Rudolph & McAuley, 1996). In other words people who possess fragile beliefs in their ability are more likely to report higher levels of perceived exertion during exercise. In addition activities which result in high levels of perceived physical strain are likely to further undermine self-belief. The manner in which exercise is presented to individuals is therefore an important consideration in terms of minimising feelings of inadequacy and overcoming barriers to exercise.

Participants have traditionally been instructed to exercise at intensities that are equivalent to a given percentage (usually between 60-80%) of estimated maximum heart rate (prescribed intensities, A.C.S.M., 1998). These exercise prescriptions fail to recognise that individuals differ in level of self-efficacy as well as physiological readiness for exercise. For those embarking on an exercise regimen the challenge of performing unfamiliar activity can in itself negatively impinge on beliefs in ability (Bandura, 1977). In addition, for those individuals suffering age related joint pain, reduced mobility or low levels of physical conditioning due to a sedentary lifestyle, exercising at a workload equivalent to a fixed heart rate can be perceived to require excessive physical effort and discomfort (Dishman, 1994).

Therefore, based on the relationship between self-efficacy and perceived exertion exercise guided by target heart rates has the potential to result in acute responses that will ultimately reduce the likelihood of on going participation. For this reason it is important to examine alternatives to these types of exercise prescriptions.

Preferred intensity guidelines represent such an alternative, and are increasingly being recommended by health agencies (e.g., Commonwealth Department of Health and Aged Care, 1999, see Appendix A) as a means of facilitating positive exercise experiences. Under these guidelines participants are not required to maintain a fixed intensity. Instead they are encouraged to adjust and maintain workload within a comfortable range during the course of a bout of exercise. Exercise intensity guidelines that accommodate personal preference have been reported to result in moderate physiological responses and levels of perceived exertion irrespective of initial fitness level of the participant (Bar-Or, Skinner, Buskirk, and Borg, 1972; Farrell, Gates, Maksud, & Morgan, 1982). Therefore potentially aversive aspects of acute exercise for less fit people are likely to be attenuated. Despite the existence of research that has examined exercise at preferred intensities (Dishman, Farquhar & Cureton, 1994) there are no known reports of research that has investigated this aspect of exercise prescription within the context of the relationship between self-efficacy and perceived exertion.

Gaining an understanding of how this relationship influences and is influenced by differing methods of monitoring exercise intensity holds important implications for health professionals aiming to encourage people to persist with moderate exercise as part of a

healthy lifestyle. As such the relationship between self-efficacy and perceived exertion during acute exercise has been chosen as the primary variable of interest in the present study.

Limited evidence suggests that exercise at preferred intensities can result in heart rate responses considered potentially harmful (Chow & Wilmore, 1984). However, whether safety implications important to older people are associated with exercise at preferred intensities remains largely understudied. In addition it has been found that some individuals self-select exercise intensities that fall below those recommended for improving health (Chow and Wilmore, 1984). Therefore the present study also provides the opportunity to examine exercise at preferred intensities from a risk / benefit perspective.

Research questions

The primary purpose of this study was to investigate the relationship between self-efficacy for exercise and perceived responses to an acute exercise bout in a group of Western Australian older adults. This was achieved by observing the relationship between self-efficacy and perceived exertion associated with acute exercise at (a) prescribed and (b) preferred intensities. A secondary purpose was to observe perceived exertion, magnitude of change in pre to post exercise self-efficacy, and heart rate responses to preferred and prescribed intensity exercise in low active participants.

The research questions for this study were:

1. Does a relationship exist between self-efficacy and perceived exertion during a single bout of exercise at a prescribed intensity?
2. Does a relationship exist between self-efficacy and perceived exertion during a single bout of exercise at a preferred intensity?
3. Do low active participants engaged in a bout of cycle ergometer exercise at a preferred intensity report lower levels of perceived exertion and favourable changes in pre to post exercise self-efficacy than participants engaged in cycle ergometer exercise at a prescribed intensity?
4. Do low active participants engaged in a bout of walking at a preferred intensity report lower levels of perceived exertion and favourable changes in pre to post exercise self-efficacy than participants engaged in walking at a prescribed intensity?
5. Do low active participants engaged in a bout of exercise at a preferred intensity experience heart rate responses which fall within a heart rate range recommended for improving health ?

Significance of the study

There are no known studies that have investigated the relationship between self-efficacy and perceived exertion during continuous exercise at preferred and prescribed intensities in older adults. As such it will contribute original findings to the body of evidence regarding acute responses to exercise and their potential influence on exercise participation.

The benefits of safe and regular exercise for older individuals have the potential to extend beyond the individual, to the family unit and to the wider community (Spiriduso, 1995). Therefore this study represents important research on a societal level.

Limited evidence suggests that the pattern of heart rate responses observed across time during continuous exercise at preferred intensities may be potentially dangerous to some older individuals (Chow & Wilmore, 1984). This is due to a lack of ability in certain individuals to consistently maintain heart rate within a recommended heart rate range, leading to excessively high cardiovascular responses at different stages of exercise. The present study provides the opportunity to observe heart rate responses to exercise at preferred intensities thus casting additional light on the merits of this method of guiding exercise intensity for promoting health while maintaining participant safety.

Increased understanding of the strength and nature of the relationship between self-efficacy and perceived exertion under varying exercise conditions will suggest future paths for research aimed at improving exercise participation rates across the wider community.

Limitations and assumptions

Practical considerations necessitated the recruitment of self-selected volunteers. Participants who displayed differing psychological states and traits thought to influence acute exercise responses, were assumed to be evenly distributed among experimental groups. However generalisation of the findings of the present study beyond the sample population, that is, healthy males and females over the age of 50 should be undertaken with caution.

It is also important to note that due to the specificity of acute exercise the findings of the present study cannot be generalised to exercise modalities or intensities other than those utilised, nor can they be generalised to long term behaviours or responses.

A number of important interactions relating to aspects of self-efficacy, perceived exertion, physical activity, and exercise undoubtedly contributed in part to responses observed in the present study. Given the complex nature of such relationships the task of establishing causal order and the relative contribution of these interactions was well beyond the aims and objectives of this research.

Exercise external to that involved in testing as well as food intake prior to testing was not monitored. The researcher asked participants to refrain from moderate and intense exercise 48 hours prior to testing. They were also asked to consume their normal food intake during this time.

It was assumed that participants were motivated to perform to the best of their abilities, that they provided genuine responses to questionnaires and attempted to follow exercise instructions. Also it was assumed that participants followed the procedures pertaining to food intake and exercise 48 hours prior to participation in the study.

Definition of terms

Older adult:	There is no consensus on what constitutes “older” people (Blair & Wei, 2000). For the purposes of this study older adult was arbitrarily defined as any person over the age of 50.
Physical activity:	Any body movement that results in a substantial increase over resting energy expenditure (Shephard, 1995).
Exercise:	A subset of physical activity defined as “planned, structured and repetitive bodily movement done to improve or maintain one or more components of physical fitness” (Caspersen, Powell & Christenson, 1985).
Exercise participation:	This term describes following ones own exercise regimen or choosing to follow one provided by someone else (Michenbaum & Turk, cited in Seraganian, 1993). In the case of the present study, exercise participation is defined as aerobic activity performed at the required intensity, on three occasions per week for twenty minutes per occasion.
Health:	This term has been defined as “a human condition with physical, social and psychological dimensions, each characterised as a continuum with positive and negative

poles. Positive health is associated with a capacity to enjoy life and to withstand challenges: It is not merely the absence of disease" (Shephard, 1995).

Physical Fitness: This term has been defined as "set of attributes that people have or achieve that relates to the ability to perform physical activity" (Casperson et al., 1985).

Self-efficacy: This term has been defined as "people's beliefs about their abilities to exercise control over events which affect their lives" (Bandura, 1989, p. 1175).

Prescribed intensity: This is the term used in the present study that represents a fixed intensity of aerobic exercise often prescribed to participants who wish to undertake an exercise regimen. In the present study this term is used synonymously with "prescribed intensity exercise".

Preferred intensity: This is the term used in the present study to describe a method of self-monitoring exercise intensity which encourages participants to exercise at their preferred level of exertion. In the present study this term is used synonymously with "preferred intensity exercise".

Perceived exertion / RPE: These terms represent the subjective measure of the level of effort reported by participants during exercise (Borg, 1985, p.27).

Emotional states: The majority of exercise psychology literature has reported effects associated with either (a) positive affect and negative affect (McAuley, Shaffer & Rudolph 1995), (b) feeling states (Hardy & Rejeski 1989) or (c) subjective states (Treasure &

Newbery, 1998). In order to avoid confusion throughout the reading of this thesis, the terms positive and negative emotional states have been used in place of positive and negative affect, positive and negative feelings and positive and negative subjective states. The use of a covering descriptor has been used previously (Treasure & Newbery, 1998), and is viewed by the author as appropriate, given the potential for confusion resulting from an acknowledged lack of clarity in basic terminology regarding feelings and emotions (Wessman, 1979).

VO₂ max:

This represents the maximal amount of oxygen that can be consumed per unit of time.

HRmax:

This notation represents the formula $(220 - \text{age}) \times 60\% - 80\%$ of maximum heart rate. It is the equation used to calculate an appropriate exercise heart rate range for participants in this study.

CHAPTER TWO

LITERATURE REVIEW

Introduction

Modern medicine, science and technology have proved highly successful in bringing a wide range of disease states and nutritional deficiencies under control (Spirduso, 1995). In Australia for example death rates for a variety of disorders including endocrine, circulatory and respiratory conditions have been reduced by approximately 30 percent since the early 1920's (Australian Institute of Health and Welfare, 1999) resulting in increases in life expectancy and an aging population. Life expectancy in Australia in 1971 was 68.0 years for males and 74.4 years for females. In 1981 that figure had increased to 71.1 years and 78.3 years respectively. In 1993 life expectancy was 74.8 years for males and 80.8 years for females (Australian Bureau of Statistics, 1995). In addition substantial increases in the proportion of older people in the population has been forecast for most developed countries leading into the 21st century (Daly & Spinks, 2000). Unfortunately, all too often gains in life expectancy are associated with a decline in physical and mental capabilities with increasing age (Katz, 1983; Tanaka, 1997). Most would agree that long life without good health and adequate physical functioning is undesirable. Widespread ill health within a rapidly aging population also has the potential to lead to negative social and financial burdens, such as pressures on extended families and soaring health care costs (Spirduso, 1995). It is estimated that in Australia the proportion of total health expenditure devoted to older people will be in excess of 50% by the middle of this century (Australian Institute of Health and Welfare,

1999). Therefore increasing value is being placed on the promotion of health habits which might reduce or delay the impact of chronic diseases and physical decline associated with aging.

Studies in a range of disciplines have reported that for older adults, a physically active lifestyle is important for health promotion and disease prevention (Arrent, Landers, & Etnier, 2000; Casper & Berg, 1998; Dimeo, Baur, Varahram, Proest, & Halter, 2001; Khatri et al., 2001). For instance significant associations have been found between participation in physical activity and favourable changes in serum cholesterol (Bijnen et al., 1996, Reaven, McPhillips, Barrett-Connor & Criqui., 1990), body composition (Rogers & Evans, 1993) and bone mineral density (Greendale, Barrett-Connor, Edelstein, Ingles, & White, 1995). These changes can in turn reduce the incidence of cardiovascular disease (Kiely, Wolf, Cupples, Beiser & Kannel, 1994; Psaty et al., 2001; Reaven et al., 1990), diabetes (Kriska, 2000) and hip fracture (Hoidrup et al., 2001). Further it has been reported that for people who already suffer from chronic conditions, regular moderate activity significantly reduces the risk of mortality (Martinson, O'Connor, & Pronk, 2001). Psychosocial benefits that have been reported following exercise include reductions in the symptoms of people suffering depression, favourable changes in mood in healthy participants and improved cognitive functioning (Arrent et al., 2000; Dimeo et al., 2001; Khatri et al., 2001).

The many benefits of exercise are now widely promoted. In Australia for example, the Active Australia initiative (D.H.A.C., see Appendix A.) represents a national promotion of physical activity that commenced in this country in 1999. The initiative serves as a means

of informing the wider community of the benefits of regular moderate activity, presenting guidelines for recommended minimum exercise levels required for good health, and suggesting strategies that might help individuals to successfully incorporate regular exercise into their lifestyle. Unfortunately despite an apparent long standing awareness of the benefits of physical activity across large sections of the community (Owen & Lee, 1989; Smith & Storandt, 1997), as well as recent initiatives such as Active Australia, less than half of Australian adults over the age of 45 participate in exercise on a regular basis (Armstrong, Bauman, & Davies, 2000; Booth, Owen, Bauman, & Gore, 1995).

A large number of factors make participation in exercise particularly problematic for older adults compared to other groups in the community (Rhodes et al., 1999). Physical incapacity due to changes associated with aging (Holloway, 1998) as well as cultural stereotypes that suggest the role of older adults is to "sit back and take it easy" (McGuire, Boyd, & Tedrick, 1996) may act as barriers. These barriers can influence perceptions and beliefs held by people in this age group. For instance Sidney and Shephard (1977a) reported a paradox of self reports of above average activity coupled with a lack of endurance fitness in a group of elderly men and women. It was posited that when participants stated that their habitual activity was "above average" they were simply mirroring the common perception that even light activity is unusual for the majority of older people (Sidney & Shephard, 1977b). Perceptions such as these lead some older adults to conclude that, for them, exercise is an inappropriate pursuit (Sidney & Shephard, 1976). Decrements in beliefs in ability (justified or not) can also result (Hogan & Santomier, 1984).

Self-efficacy (Bandura, 1977) refers to the level of confidence a person possesses in their ability to complete a target behaviour. Self-efficacy has been reported as a particularly important influence on the success or failure of initial attempts to incorporate both formal and unsupervised exercise into one's lifestyle (McAuley, 1991, 1993; McAuley & Jacobson, 1991; O'Brien Cousins, 1996). McAuley and Jacobson (1991) examined the role of selected biological and psychosocial variables in the prediction of exercise behaviour in sedentary adult females. Analyses of variance revealed that efficacy beliefs reflected the degree of compliance to the activity program. The authors concluded that participants' beliefs in being able to regularly exercise in spite of real or perceived barriers were an important component of compliance with exercise programs. McAuley (1991) followed a group of 45-64 year olds for five months in order to study the process of exercise participation from adoption to maintenance. Statistical analysis examining the role of efficacy, perceptual, and behavioural indicators of frequency and intensity of exercise indeed revealed self-efficacy as a predictor of exercise adoption. In a separate analysis (McAuley, 1993) the same group was investigated four months after the completion of the formal program. Self-efficacy significantly predicted exercise behaviour during the intervening period. Finally O'Brien Cousins (1996) found self-efficacy to be among the best predictors of participation in a variety of leisure time activities in a group of older Canadian females.

A complex relationship has been reported to exist between self-efficacy and perceived exertion (Rudolph & McAuley, 1996). Indeed it has been proposed that the interaction between these two variables during acute exercise is in part responsible for the crystallisation and modification of an individual's belief in his or her ability to successfully

negotiate exercise tasks (Rudolph & McAuley, 1996). The first part of this chapter will present a review of the literature pertaining to (a) self-efficacy and (b) perceived exertion. The section will conclude with an analysis of the limited amount of published research pertaining to the relationship proposed to exist between these factors.

Self-efficacy

Self-efficacy has been defined as “people’s beliefs about their abilities to exercise control over events which affect their lives” (Bandura, 1989, p. 1175). Self-efficacy theory is a relatively recent addition to a large number of personal competence theories that examine human action, motivation, and emotion (Maddux, 1995). Expectations of personal efficacy (the perceived ability to perform a specific behaviour) have been posited as “major determinants of whether a behaviour will be initiated, how much effort will be expended and how long effort will be maintained in the face of obstacles and aversive experiences” (Bandura, 1977).

It is important to point out that several theories relating to Self-efficacy are often used interchangeably in the research literature (Bandura, 1997). Constructs such as self-concept, global self-esteem, behavioural intentions and perceived behavioural control differ in the way in which they view the nature and origins of efficacy beliefs, the effects they have, their changeability and their generality (Bandura, 1997). Therefore it is important not to confuse these theories with self-efficacy.

There are also a large variety of instruments that have been used to measure self-efficacy. McAuley and Mihalko (1997) reviewed 85 published articles that employed self-efficacy measures of some form. It was noted by these authors that the measurement of self-efficacy specifically relating to the exercise setting has, in the past, relied on measures not necessarily suited to or not sensitive enough for, the field (McAuley & Mihalko, 1997). General efficacy beliefs assess factors termed “generalised self-efficacy, trait self-efficacy or physical self-efficacy”. These types of measures are seen to be less likely to be predictive of responses to exercise, and importantly are unlikely to be changed as a function of exposure to acute bouts of exercise, as are more specific measures. In addition many scales have consisted of single or few items in order to simplify the testing protocol. McAuley and Mihalko (1997) note that this endeavour may lead to the sacrifice of good measurement for the sake of brevity. In sum the authors stress the importance of utilising measures that are very specific to the activity concerned, that employ a high enough degree of sensitivity with which to measure changes in level of self-efficacy resulting from acute bouts of activity.

Basis of Self-efficacy Theory

Central in understanding self-efficacy is the notion of triadic reciprocal causation (Bandura, 1997). The term causation refers to the dependence or interaction between specific events. It is stated that internal personal factors in the form of cognitive, emotional and biological events; behaviour; and elements contained in the environment all operate as interacting determinants that influence each other during the development, maintenance, and modification of efficacy beliefs (Figure 2.1, Bandura, 1997). The relative influence of each

of the determinants is therefore highly dependent upon the particular set of circumstances under which tasks are performed (Bandura, 1997).

Influence of Self-efficacy on Thought and Action

Individuals high in self-efficacy view situations as presenting realistic opportunities and visualise successful outcomes (Bandura, 1990). For instance Weinburg, Gould, Yukelson, and Jackson (1981) classified 96 college students as either high or low in pre-existing self-efficacy to complete a muscular leg endurance task. Those higher in self-efficacy were more confident that they would score in a higher percentile than other college students on leg strength and endurance tasks, compared to the low self-efficacy group. In addition high efficacy participants expected to perform the task significantly better than low efficacy participants and this was found to be the case.

Self-efficacy theory also states that strong beliefs in ability often transform into superior performance and heightened motivation characterised by active and self-determined courses of action even in the face of obstacles (Bandura, 1997; Schwarzer & Renner, 2000). Conversely, those low in self-efficacy are thought to view uncertain situations as threatening and are inclined to visualise negative outcomes (Bandura, 1997). Excessive contemplation of how things might go wrong is thought to undermine self-motivation and performance (Bandura, 1997). During the course of the experiment conducted by Weinberg et al. (1981) each participant performed two trials of the experimental task. Failure on the first task was reported to result in intensified motivation and effort on the part of those high in pre-task

self-efficacy. However those low in pre-task efficacy exhibited decrements in performance and motivation following initial failure (Weinburg et al., 1981).

Sources of Self-efficacy

Beliefs about personal abilities are built on the complex interaction of a number of primary sources of efficacy information (Bandura, 1997). The most relevant in the context of the present study are (a) performance or mastery experience, (b) physiological arousal and (c) emotional states. Other sources of efficacy information consist of vicarious experiences, in which perceptions of competence are based on comparison, and verbal persuasion which influences perceptions of confidence through social influence (Bandura, 1997). Performance experiences are thought to represent the most powerful sources of efficacy information (Bandura, 1997). Clear success at a task raises efficacy expectations whereas perceptions of failure lower them. For instance a person who attempts to exercise on a given day but fails to successfully complete the exercise task will probably doubt their ability to succeed at future attempts. On the other hand a person who is successful at initial attempts may hold strong efficacy beliefs regarding future participation.

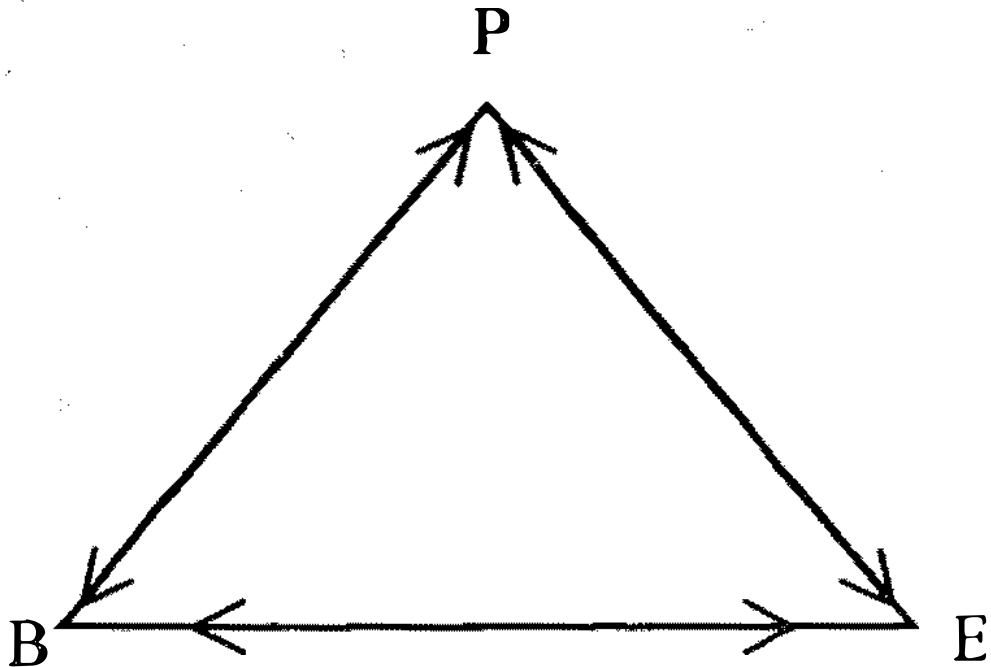


Figure 2.1. The relationship between the three major determinants of triadic reciprocal causation. B represents behaviour; P represents internal personal factors; E represents the environment. (Adapted from Bandura, 1997)

In settings laden with somatic feedback such as exercise, physiological and emotional responses interact to play a substantial role as sources of efficacy information. Physiological responses can negatively influence self-efficacy if the participant associates physiological arousal with negative outcomes such as poor performance or lack of ability. Conversely, relatively comfortable physical sensations are likely to result in feelings of confidence in a person's ability to successfully deal with demands imposed by the task (Bandura, 1997). Emotional experiences associated with tasks such as exercise are not simply the product of physiological arousal and therefore represent an additional separate source of efficacy information. Reduction of aversive emotional responses is thought to result in greater experience of mastery over a particular task and ultimately heightened beliefs in ability for

individuals who initially perceive their own ability to be less than adequate. In turn once strong self-belief is established the negative effect of aversive emotional responses on self-efficacy are diminished (Bandura, 1997).

The interaction between age, physiological and emotional responses to exercise may represent a particularly important influence on self-efficacy. Support for this suggestion comes from a study conducted by McAuley, Schaffier, and Rudolph (1995). Volunteers ranging from 45-85 years of age completed upper body exercise at 70% estimated maximum heart rate (HR_{max}). Highly efficacious individuals reported a greater number of positive and fewer negative emotional responses to exercise. Moreover older individuals were less efficacious and reported a greater number of negative emotional responses to exercise including distress and fatigue, than did their younger counterparts (McAuley et al., 1995).

Treasure and Newbery (1998) examined the interaction between self-efficacy and emotional responses to acute exercise at varying levels of physiological demand. Sixty sedentary college aged participants were assigned to either a moderate intensity (50% of maximum), a high intensity (75% of maximum), or a no-exercise control group. Those participants who were lower in pre-existing self-efficacy level experienced a greater number of negative emotions to the exercise stimulus. In addition an inverse relationship was observed between in-task negative emotions and self-efficacy. This relationship was stronger at higher exercise intensities.

In a young, active population Tate, Petruzellos, and Lox (1995) reported that although self-efficacy increased pre to post exercise, emotional responses did not predict these increases, thus their findings did not support the argument for reciprocal determinism of emotional responses to exercise. Furthermore, no effect of exercise intensity was observed on the relationship between pre and post exercise self-efficacy and emotional responses to exercise (Tate et al., 1995). Two reasons have been put forward as explanations for inconsistency between findings of the studies previously reviewed. The first is that the exercise task in the study by Tate and colleagues was not sufficiently challenging to elicit increases in efficacy in the high active participants used for the experiment (Treasure & Newbery, 1998). The second is that ceiling effects for self-efficacy may have prevented detection of increases in self-efficacy in the study conducted by Tate and colleagues (Tate et al., 1995).

In another study of young, active individuals (mean age 21 years) Parfitt, Rose, and Markland (2000) compared the effects of 20 minutes of treadmill exercise at either prescribed (65% VO_2 max) or preferred intensities on emotional responses to exercise. No differences were observed in emotional responses between the two exercise conditions although work rate was higher in the preferred condition. However, it was noted that pre-exercise emotions played an influential role in emotional responses during exercise. The findings were taken to indicate that allowing fit individuals to select their own exercise intensity may result in both physiological and psychological benefits (Parfitt et al., 2000).

The findings of the previous experiments taken together support the theoretical proposition that a wide range of contextual factors impinge on the impact of efficacy-laden information (Bandura, 1997). The findings also support a contention that (a) older adults may be vulnerable to decrements in existing levels of self-efficacy for exercise compared to their younger counterparts, (b) exercise at higher intensities is more likely than exercise at lower intensities to result in negative emotional responses (c) these responses are capable of negatively impacting on an individual's post task assessment of their own exercise ability and (d) emotional responses to exercise at preferred intensities may be influenced by pre-existing personal characteristics. Whether perceptions of exertion, pain and fatigue resulting from physiological responses to exercise represent emotional states per se is debatable (McAuley & Courneya, 1996). Nevertheless the studies previously discussed clearly demonstrate that physiological cues have the potential to generate subjective responses. As such they also lend support to a hypothesis previously proposed by Rudolph and McAuley (1996) that it would be reasonable to expect level of self-efficacy to be inversely related to perceived exertion.

Perceived Exertion

Perceived exertion can be defined as "the act of detecting and interpreting sensations arising from the body during physical exercise" (Noble & Robertson, 1996, p. 4). In simple terms perception of effort represents the degree of physical strain a person feels during physical tasks. Perception of effort has been applied in the area of exercise testing and prescription across a wide variety of athletic, clinical and recreational populations (For

review see Watt & Grove, 1993). A large number of factors are thought to contribute to the sensations of effort one experiences during the course of an exercise bout. The following paragraphs will describe (a) physiological and (b) psychological determinants of effort sense and the way in which they are integrated to produce a conscious signal or “sense of effort”.

Physiological Determinants of Effort Sense

It was originally thought that heart rate played a major role as a contributor to effort sense. However, correlations between heart rate and perceived exertion varied between 0.42 and 0.94, when different tasks such as treadmill walking (Skinner, Hustler, Bersteinova, & Buskirk, 1973), one and two limb exercise (Gamberale, 1972) and riding a cycle ergometer (Borg, 1973) were compared. In addition Stoudemire et al. (1996) observed an uncoupling of heart rate and perceived exertion during 30 minutes of continuous exercise. These findings suggest that heart rate per se is not a major determinant of effort sense.

Minute ventilation (V_E) has also been posited as a contributor to effort sense. Robertson (1982) reviewed several studies that observed correlation coefficients of between .61 and .94 between perceived exertion and V_E during cycling exercise at differing intensities and in thermoneutral versus hot conditions. However the relationship between perceived exertion and V_E appears to be dependent upon exercise intensity, such that perceived exertion parallels V_E at workloads above 50% $\dot{V}O_2$ max.

A number of investigators have stated that the rate of oxygen consumption ($\dot{V}O_2$) provides the strongest central signals of exertion, with correlation coefficients between $\dot{V}O_2$

and perceived exertion of between 0.76 and 0.97 (Robertson, 1982). Importantly, it appears that relative ($\% \dot{V}O_2$) rather than absolute $\dot{V}O_2$ correlates most highly of all (Robertson, 1982). Eston and Connelly (1996) studied the effects of Beta-blocker therapy on perceived exertion for patients suffering cardiovascular disease. They found that although the therapy resulted in increased effort for the same absolute workload, there was no difference when workload was expressed as a percentage of $\dot{V}O_2$ max.

The preceding studies highlight potential contributions to effort sense governed by cardio-respiratory mechanisms. In addition there are a number of peripheral physiological factors that are thought likely to contribute to perceived exertion during exercise. Of these the strongest evidence appears to support the theory that the degree of anaerobic metabolism (as measured by blood lactate concentration) is one of the most important determinants of peripheral effort sense. Caffarelli (1982) found that during continuous exercise under conditions of induced acidosis (80% $\dot{V}O_2$ max), an extreme increase in perception of effort was not accompanied by an increase in activity in the working muscles as measured by electromyography. This suggested that, during heavy exercise, acidosis may contribute in some way to increased perceived exertion.

Integration of Respiratory and Peripheral Determinants

The perception of physiological cues of exertion usually refers to a general or overall perception of effort (Borg, 1985). It appears that this perception represents an integration of a number of signals from both the respiratory and peripheral mechanisms previously discussed. Indeed Robertson, Gillespie, McCarthy, and Rose (1979) state that overall or

undifferentiated perception of effort probably represents a superordinate level of effort sense not directly linked to the underlying physiological processes, but rather a complex integration of many differentiated sensations, arising from specific physiological events. Each of these events has its own perceptual weighting based on the body region predominantly involved in a particular work task (Robertson et al., 1979). In support of this argument various authors (Astrand & Rodahl, 1977; Ekblom & Goldbarg, 1977; Gamberale, 1972, cited in Robertson et al., 1979) have reported that in activities such as cycling (where the majority of the work is produced by the legs), peripheral perceived exertion dominates the overall perception of effort.

Psychological Determinants

A number of psychological factors, both situational and dispositional are also believed to play a role in the setting of the perceptual signal. For instance expectations of longer compared to shorter exercise duration (Rejeski & Ribisl, 1980), positive reinforcement from another person during exercise (Hardy, Hall, & Presholdt, 1986), manipulation of attention away from the exercise task (Johnson & Siegal, 1987; Pennebaker & Lightener, 1980), and exercising at times other than very early in the morning (Trine & Morgan, 1995) have all been reported to attenuate perceived responses to exercise at low to moderate intensities. In addition personality traits (Morgan, 1973), and cognitive style (Jones & Cale, 1989; Morgan & Pollock, 1977) all represent psychological factors that have been shown to contribute to perceived exertion in exercise settings.

Integration of Physiological and Psychological Determinants

Various models have been adopted in order to explain the integration of physiological and psychological signals into a conscious sense of effort. Perceived exertion was originally viewed in terms of a passive approach. In other words it was assumed that a given stimulus (eg physical work), initiated sensory cues via changes in physiological parameters which in turn resulted in perceptions of exertion (Borg, 1973).

Later the parallel processing model of pain (Leventhal & Everhart, 1979) was adapted for the study of perceived exertion (Rejeski, 1985). This model considers information and emotional components of effort sense to exist in parallel fashion and distinguishes between perception and focal awareness. Perception refers to all the processed material to which one can attend, whereas focal awareness represents that segment of potential stimuli to which one *does* attend (Rejeski, 1985). The parallel processing model is based on the assumption that a limited number of attentional “channels” are available for information processing at any given moment in time (Leventhal & Everhart, 1979). While physiological input along with focal awareness play a role in perception of exertion, Rejeski proposed that effort perception is an active process, influenced by such factors as learning, experience and pre-existing beliefs (Rejeski, 1985).

To this end Cioffi (1991) proposed a cognitive perceptual model of somatic interpretation in which not only perceptual focus but also existing attitudes, beliefs, goals,

coping strategies, and attributions influence the interpretation of somatic stimuli (Figure 2.2). Cioffi explains that the attention a person pays to physical sensations should be distinguished from possible meanings, implications, sources and consequences. An illustration of this model as it would operate in the exercise domain, adapted from Cioffi (1991) is presented in the following paragraph.

While engaging in cycle ergometer exercise heart rate begins to increase (an objective *physical state*). If the participant's attentional focus is shifted by outside thoughts such as work to complete later in the day or by social influence of a person engaging them in conversation, the physical state may be ignored. If this is not the case however, the participant will likely become aware of sensations of effort. Once this is noticed it becomes a *somatic label*. The participant will *attribute* the sensations to something or other, based on their own cognitive style. If the feelings of effort or strain are interpreted negatively by the participant these sensations can become "symptoms" of pre-conceived deficiencies such as lack of fitness or lack of skill at cycling. In this case a *pre-existing hypothesis* has impinged on the meaning of perceived physical sensations and is thus reinforced. Conversely if the sensations arising from exercise are interpreted as evidence of impending exercise benefits such as increased level of fitness, they can serve to maintain or even increase effort and motivation. In either case the result of these attributions will in turn influence future responses to the same stimuli. Finally mediating factors such as personality, mood, goals (such as task duration), and coping strategies will all play a role in acute responses to the activity.

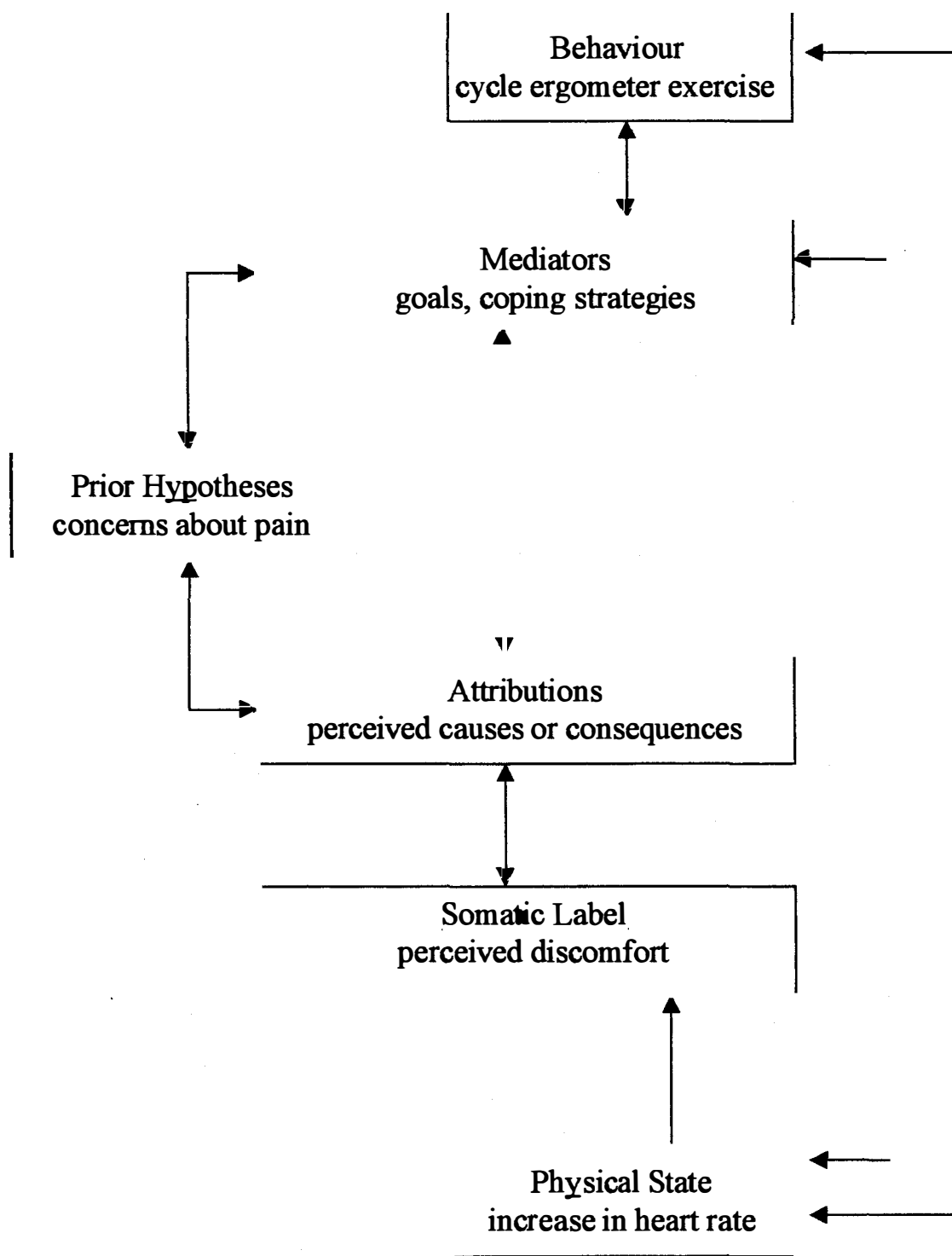


Figure 2.2. Components of somatic interpretation. (Adapted from Cioffi, 1991)

The previous illustration serves to demonstrate four key points. First that the same somatic label (level of perceived effort) can be interpreted in many differing ways. Second, any stage in the process – from becoming aware of a sensation to responding to it, can affect or be affected by several of the others. Third, any of the influences has the potential to impact on the strength and meaning of the actual somatic sensation. Fourth, the weighting of attention paid by a participant to any one of the influences at any point in time is highly variable (Cioffi, 1991).

The model of somatic interpretation proposed by Cioffi provides a theoretical foundation on which to ground the findings of the literature previously reviewed in this chapter, which reported substantial interplay between contextual factors, existing beliefs, physiological and emotional responses to exercise. Therefore by extension the model also provides a sound theoretical basis for the present study, which aims to examine the proposition that a relationship exists between self-efficacy and perceived exertion.

Relationship Between Self-efficacy and Perceived Exertion

Few studies have explored the relationship between self-efficacy and perceived exertion during acute exercise. The results of these studies have provided conflicting evidence for the existence of such a relationship. McAuley and Courneya (1992) recruited older volunteers (mean age 53 years) who completed a cycle ergometer incremental exercise test. Although it was observed that more efficacious participants reported lower perceptions of effort than did their less efficacious counterparts, no significant correlation was found between perceived exertion and post exercise efficacy beliefs (McAuley & Courneya, 1992).

In a later study Rudolph and McAuley (1996) examined the relationship between self-efficacy and perceived exertion in a sample of young male volunteers (mean age 21 yrs) during continuous running at 60% VO_2 max. Pearson correlation revealed a negative and significant correlation between (a) pre exercise self-efficacy and perceived exertion and, (b) perceived exertion and post exercise self-efficacy. Those participants who possessed high pre and post exercise self-efficacy reported lower perceptions of effort compared with their less efficacious counterparts (Rudolph & McAuley, 1996). In addition those participants who perceived the exercise bout to require less effort reported stronger post exercise beliefs in ability. Rudolph and McAuley (1996) cited a failure to directly measure VO_2 max and to match measured values with relative exercise intensities as an explanation for the failure to observe a reciprocal relationship in the earlier study (McAuley & Courneya, 1992).

The findings of the only known experiment that has examined the relationship between self-efficacy and perceived exertion during continuous exercise similar to that most commonly performed in free living settings supports the existence of the relationship between these factors (Rudolph & McAuley, 1996). Based on these findings in conjunction with the body of theoretical and empirical literature reviewed previously, it was tentatively hypothesised in the present study that a significant reciprocal relationship would be observed between self-efficacy and perceived exertion in older adults performing 20 minutes of walking or cycle ergometer exercise. Rudolph and McAuley (1996) went on to suggest that it would be valuable in future studies to examine factors which possess the potential for reducing the negative impact of perceptions of effort during exercise, such as varying

exercise intensities. Further it was stated that the study of different methods of self-monitoring exercise intensity and the subsequent impact of these methods on self-efficacy represented important future research (Rudolph & McAuley, 1996).

Exercise at Prescribed Intensities

Traditional methods of determining exercise intensity require participants to maintain a constant workload, usually based on a given percentage of estimated maximal heart rate (American College of Sports Medicine, 1995). A variety of estimation methods are utilised in order to monitor heart rate during exercise. Two estimation methods commonly employed in field settings such as gym facilities and in public health programs, including the Active Australia initiative are described as follows. The first of these determines exercise intensity as a percentage of heart rate reserve (HRR). The HRR is determined by subtracting the resting heart rate from the maximal heart rate. In free living settings maximal heart rate is usually estimated by calculating the age predicted maximal heart rate or by using the equation $(220 - \text{age})$. A pre-determined percentage (e.g. 60 - 80 %) of this heart rate is then added to the resting heart rate.

A second method, the maximum heart rate (HR_{max}) method also utilises the equation $(220 - \text{age})$. Using this method the target heart rate is estimated by simply selecting a pre-determined percentage of the maximal heart rate. A target heart rate that is derived from a percentage of HR_{max} is approximately 10% lower than that calculated by the HRR method (Noble & Robertson, 1996). Although heart rate prescriptions are widely

used in free living settings such methods are not free of drawbacks. They may in some cases result in unfavourable acute physiological and perceptual responses and present practical difficulties for participants.

Physiological and Perceptual Responses

Direct measurement of maximal heart rate is impractical in non-clinical settings. Instead the target heart rates are based on estimates derived from normative tables that are associated with considerable individual error (Williams & Eston, 1989). In addition such prescriptions do not account for differences in heart rate responses to differing exercise modes. For example in swimming, heart rate maximum has been reported to average some 10-13 beats per minute lower than for running (McArdle, Magel, Delio, & Chase, 1978). Finally the linear relationship between heart rate and VO_2 on which the prescription is based can be distorted by a variety of factors including high ambient temperature (Young, Cymerman, & Pandolph, 1982) and certain medications (Eston & Connelly, 1996). This can lead to over or underestimation of exercise intensities.

Given the above stated potential for error it should not be surprising that exercise at a given percentage of maximum heart rate has been reported to result in large individual variations in relative metabolic stress (Weltman, 1995; Weltman et al., 1990). Therefore the perceived effort required to complete exercise at intensities based on absolute workloads will also vary, with some participants reporting that exercise intensity guided by predicted heart rate ranges is too hard (Dishman, 1994).

A further disadvantage of the use of heart rate for the prescription of exercise intensity is based on practical considerations. Because electronic heart rate monitoring is expensive and impractical in most free living settings, exercise intensity based on a percentage of maximal heart rate is often monitored by the palpation method. Having to continually monitor heart rate using this method can be difficult for some individuals to master and also detract from pleasurable aspects of the exercise experience when the activity has to be temporarily ceased in order to obtain the heart rate (Dishman, 1994).

Exercise at Preferred Intensities

Traditional exercise prescriptions have been associated with low participation rates (Caspersen, Christenson, & Pollard, 1986). This, combined with evidence that participation is inversely related to exercise intensity (Pollock et al., 1991), have resulted in the suggestion that many people prefer to exercise at different intensities than those recommended by traditional intensity prescriptions (Dishman, et al., 1994). An alternative to prescriptions based on estimated maximum heart rate are self-paced or preferred intensity guidelines which allow participants to initially select and then modulate workload throughout the course of an exercise session depending on their preferred level of exertion. Put simply, participants are encouraged to commence and then maintain exercise at heightened or decreased levels of perceived exertion independent of a specified target workload. Such guidelines vary in their specific wording, but are commonly characterised by an emphasis on “moderate exercise” as opposed to “vigorous exercise” at a target heart

rate (D.H.A.C., 1998, refer Appendix A). The flexibility afforded participants during preferred intensity exercise no doubt contributes to the considerable intuitive appeal of these prescriptions in a variety of exercise settings and for use with large groups of people who differ in physical and psychological readiness for exercise.

Physiological and Perceptual Responses

Moderate relative metabolic and perceptual intensities have been associated with exercise at preferred levels of exertion in both young and older populations and groups differing in fitness level. Bar-Or et al. (1972) recruited 19 sedentary and 51 physically active men aged 41 to 60 years to participate in treadmill and bicycle ergometer exercise testing. The researchers reported that participants as a group preferred to walk or cycle at about 50% of estimated maximal work capacity. Farrell et al. (1982) instructed trained male runners (mean age 30 years) to exercise for 30 minutes on a treadmill at a self-selected pace. Participants reported that the exercise task elicited intensities they perceived as moderate. Dishman et al. (1994) compared perceived exertion during exercise at preferred intensities in a group of male students differing in activity level. Participants completed twenty minutes of cycle ergometer exercise. Once again both groups reported moderate levels of perceived exertion. Interestingly the high active group selected higher power outputs, however no differences were observed between groups for physiological indicators of relative exercise intensity (%VO₂, blood lactate concentration).

The findings of the above studies taken together indicate that variations in the level of perceived exertion which might be expected to occur under differing conditions such as (a) differing exercise modalities and, (b) across differing sub-populations during exercise at prescribed intensities largely disappear during exercise at preferred intensities. The findings are also encouraging in terms of the potential health benefits associated with exercise at preferred intensities. A number of authors have reported that exercise training programs conducted at moderate physiological and subjective intensities elicit improvements in aerobic power in elderly participants (De Vries, 1971; Badenhop et al., 1982; Belman & Gaesser, 1991).

Safety Considerations

Despite the promise of preferred intensity guidelines for eliciting favourable exercise responses, the use of such methods may carry important safety implications. Chow and Wilmore (1984) asked a group of male participants aged between 18 and 30 years, to exercise for 15 minutes at an intensity at which they would exercise if they wanted to “get in shape”. Although mean heart rates approximated those observed during exercise guided by traditional heart rate prescriptions, individual scores demonstrated considerable variability (Chow & Wilmore, 1984). Importantly, 25% of five minute means were significantly above a recommended training heart rate. As stated by the authors, although exercise at high intensities might only produce discomfort for healthy individuals, it can be potentially dangerous for those at greater health risk during exercise. This is a significant consideration for older adults who generally experience greater health risks associated with vigorous

exercise than other groups in the general population (White, Fehlaue, Hanover, Johnson, & Dustman, 1998).

Summary and Conclusions

Traditional methods of monitoring intensity are, by their nature, inherently opposed to allowing participants the freedom to moderate potentially aversive responses that may result during the course of a bout of exercise. Preferred intensity prescriptions however, allow participants to initially select their preferred workload, then adjust that workload at any time during exercise thereby providing the opportunity to address physiological and emotional responses that might be perceived as negative by an individual engaged in exercise. Therefore preferred intensity prescriptions may be more likely than traditional methods to be congruent with the abilities, motivation and expectations of people for whom the primary exercise goal is to establish and maintain regular exercise patterns, rather than merely improve physiological functioning. However whether this is actually the case remains equivocal due to a lack of empirical research conducted to date. Indeed no known research has observed the relationship between self-efficacy and perceived exertion during continuous exercise in older adults.

The preceding review of literature suggests that modification of intensity guidelines alters the strength and nature of their impact on acute physiological and perceptual responses to exercise. Therefore it seemed reasonable to question whether differences between exercise at preferred compared to prescribed intensities would be reflected in the

strength of the relationship observed between self-efficacy and perceived exertion. Finally the present study provided the opportunity to observe whether for low active participants, differences would be observed in the magnitude of acute physiological, perceptual and psychological responses to prescribed and preferred intensity exercise.

CHAPTER THREE

METHODS

Recruitment and Participants

Edith Cowan University Ethics Committee approved the methods used in the study. Methods of informing the general public of the study and recruiting volunteers consisted of (a) addressing local seniors' leisure and recreation organisations, (b) advertising in local seniors newspapers, (c) via interviews conducted on local radio and (d) information sheets placed in public facilities such as libraries and shopping centres across a range of suburbs in the Perth metropolitan area. People left contact details on a voicemail service based at Edith Cowan University Joondalup campus. A total of 164 people responded. Those who did so were subsequently contacted to confirm that they met the inclusion criteria. It was a requirement for inclusion that participants were free of cardiovascular or musculo-skeletal conditions that might contraindicate participation in continuous exercise. A health risk questionnaire, administered verbally is contained in Appendix B. Participants were also asked to complete the questionnaire in writing immediately prior to participating in the study.

Respondents completed a self-report exercise questionnaire (Kasari, 1976, Appendix C). People reported frequency, intensity and time spent in regular exercise. They were asked to report only those activities they performed "specifically for exercise, such as walking or fitness classes as opposed to incidental exercise during shopping, work around

the house etc". Responses to the questionnaire were used in order to calculate an exercise score of between 3 and 100 for each participant. Higher exercise scores represented a greater degree of participation in exercise activities. This type of exercise rating has been demonstrated to correlate with estimates of aerobic capacity (Roth, 1989), and represented a time efficient method of obtaining the required information for the current study, although it is acknowledged that more sensitive measures of physical activity may be more appropriate depending on the specific aims of an experiment. Post hoc analysis of data obtained from the present sample produced significant correlations between participant's exercise questionnaire score and (a) sum of four skinfolds ($n = 80$, $r = -.39$, $p < .01$), and (b) blood lactate response to exercise ($n = 24$, $r = .74$, $p < .01$). Those who scored higher were both leaner and displayed enhanced exercise tolerance compared to those who recorded a lower score. Therefore the use of the exercise questionnaire appears to have been successful in identifying individuals who differed in personal characteristics and exercise responses reported to be attributable to exercise participation (Belman & Gaesser, 1991; Dishman & Gettman, 1980). Distribution of activity questionnaire scores ($M = 40.2$, $SD = 20.9$) are presented in Figure 3.1.

Respondents were matched for gender then placed into one of three groups, high active, moderately active and low active. In order to meet the criteria of the high active group, respondents needed a score of 60 or above. In practical terms this means that high active respondents had to engage in regular exercise a minimum of 3-5 times per week, at an intensity which elicited at least moderately heavy breathing for a minimum of 30 minutes on each occasion. In order to satisfy requirements of the low active group respondents needed

a score of 20 or below, representing exercise for a maximum of 1-2 occasions per week at a maximum of light to moderate intensity and for a maximum of 20-30 minutes. Participants whose activity scores fell between these two groups were deemed to be moderately active.

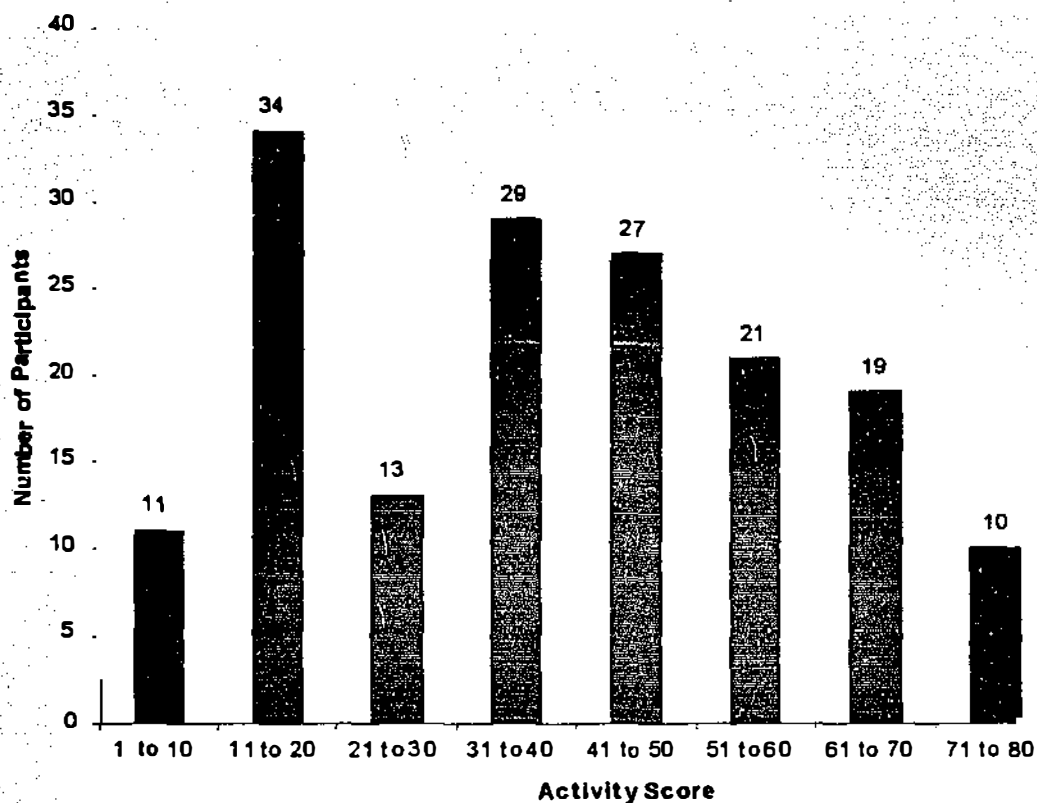


Figure 3.1. Distribution of exercise questionnaire scores obtained from 164 respondents.

Assignment to Experimental Groups

Equal numbers of males and females from each of the high, moderate and low active groups were randomly selected from the pool of respondents, contacted and asked to participate in the study. This process continued until three groups equal in number ($n = 24$) and matched for age, gender and exercise score were obtained. The three groups completed one of three exercise tasks: cycle ergometer exercise at a prescribed intensity (PSC), cycle

ergometer exercise at a preferred intensity (PFC) or walking at a preferred intensity (PFW).

The data from these groups was used to answer research questions one and two.

Data obtained from low active participants who completed prescribed cycle ergometer exercise (LPSC, $n = 8$), preferred cycle ergometer exercise (LPFC, $n = 8$), and preferred intensity walking (LPFW, $n = 8$) was analysed separately. A fourth group also consisting of age and gender matched low active participants were recruited. These individuals participated in walking at prescribed intensities (LPSW, $n = 8$). The data from these four groups was used in answering research questions three, four and five

From the processes previously described a total of 80 respondents were recruited and subsequently participated in the study. Means (\bar{M}), standard deviations (SD), and range (\bar{R}) of the study sample are presented in Table 3.1. Participants comprised males ($n = 40$) and females ($n = 40$). Mean age of the sample was 62.5 years (SD = 4.5 yrs). A one-sample t -test revealed that mean self-report exercise scores as well as distribution of scores were consistent with means and distribution of scores obtained from the 164 respondents during recruitment. In addition participants' mean body mass ($\bar{M} = 70.9$ kg, SD = 10.4) and sum of four skinfolds ($\bar{M} = 55.6$ mm, SD = 12.8) were consistent with published norms for the study age group (Gore & Edwards, 1992). This indicates that the personal characteristics of the sample were representative of a wider population. No significant gender differences were observed for personal characteristics of the sample.

Table 3.1

Participant characteristics (N = 80)

Characteristic	M	<u>SD</u>	<u>R</u>
Age (Years)	62.5	4.5	51 - 70
Body mass (Kg)	70.9	10.4	45 - 98
Sum of four skinfold (mm)	55.6	12.8	37 - 84
Exercise Score	35.9	22.0	3 - 80

Measures and Equipment

Self-efficacy.

Exercise self-efficacy was measured using an eight item scale specific to the activity in line with McAuley et al. (1991). Participants were asked to rate confidence in their own ability to exercise for 5, 10, 15, 20, 25, 30, 35 and 40 minute increments. Participants degree of confidence in their ability at each increment was indicated on a 100 point

percentage scale consisting of 10 point increments, with 100% = completely confident and 0% = not at all confident. Efficacy scores were determined by summing all ratings and dividing by the number of items on the scale, resulting in a possible maximum efficacy score of 100. Internal consistency of scales of this type has previously been reported ($\alpha > .80$, Cronbach Alpha; McAuley et al., 1991). Evidence for the validity of self-efficacy measures is believed to lie in their ability to produce correlations with related measures (McAuley & Mihalko, 1997). For example if a participant's confidence in being able to exercise is high then it is reasonable to expect that other measures of exercise such as workload should also be correlated with the self-efficacy measure (McAuley & Mihalko, 1997). Post hoc analysis of the present data revealed that a significant correlation existed between self-efficacy and workload ($r = .67$, $p < .01$) during cycle ergometer exercise at exercise at preferred intensities ($n = 24$). A copy of the self-efficacy scale appear in Appendix D.

Perceived Exertion

Ratings of perceived exertion (RPE) were measured using the Borg RPE scale (Borg, 1962, Appendix E). The scale consists of a 15 point category scale covering the total range of perception from extremely light exercise to extremely hard exercise. In addition verbal anchors ranging from "very very light" to "very very hard" are placed at various positions on the scale. The validity of the Borg scale has been previously established (Skinner et al., 1973; Stanford, 1976), and has been widely adopted for use with clinical and asymptomatic populations. Test-retest reliability has ranged from .76 to .94 (Gamberale, 1972; Skinner et al., 1973; Stanford, 1976). Participants were asked to provide an overall

estimate of perceived exertion based on combined feelings of strain arising from both respiratory-metabolic (chest) and peripheral (legs) sources. Specific instructions issued to participants are presented in Appendix F.

Cycle Ergometer

The cycle ergometer used in the study (Repco MK III air braked, Repco, Victoria) was calibrated according to manufacturer specifications prior to each testing session. Seat height and handle bars were adjusted for each participant and the workload indicator was masked from participants view by means of a cover device. The experimenter was able to view and record workload at the required time intervals.

Heart Rate

Heart rate was measured using a Polar PE 4000 Sports-tester (Polar Electro, Finland). A chest strap was placed around the participant's chest. During cycle ergometer protocols the wrist watch receiver was located on the handle bars of the cycle ergometer. During walking protocols the receiver was placed on the wrist of participants. During exercise protocols utilising traditional heart rate prescriptions the receiver was visible to both the experimenter and participants. During protocols utilising preferred intensity the heart rate display on the wrist watch receiver was masked.

Skinfolds and Body Mass

Skinfolds were measured using John Bull skinfold callipers (British Indicators, England). Measurements were taken in accordance with guidelines obtained from Australian Fitness Norms (Gore & Edwards, 1992). Measures for four skinfold sites (bicep, tricep, subscapular, suprailiac) were totalled in order to obtain sum of four skinfolds. Body mass was measured prior to exercise using a SECA weighing scale. All measurements were carried out by the experimenter. Coefficient of variation (V) was calculated using methods described by MacDougall, Wenger, and Green (1991, p.76), using a sample of eight participants. V was below 10% for each of the above measures.

Procedures

All cycling data was collected at the exercise physiology laboratory at Edith Cowan University, Joondalup campus. All walking data was collected at the physical education gymnasium at Edith Cowan University, Churchlands campus. Ambient temperature at both venues was consistently recorded between 20 and 24 degrees Celsius. Relative humidity was consistently recorded between 55 and 65%. Data collection was conducted at various times of the day in order to suit participant's time schedules.

Each participant received a written handout explaining the proposed research (Appendix G) and signed a written consent form (Appendix G) prior to participation in the study. In addition all participants were asked to complete the health risk questionnaire

(Appendix B). Upon a participant arriving at the laboratory the experimenter explained (a) the nature of the experiment, (b) the exercise task participants would be asked to perform, (c) how to monitor exercise intensity during exercise, (d) how to gauge RPE, and (e) how to complete the self-efficacy scale. Participants were tested individually. Confidentiality was maintained by assigning each participant a number.

Prescribed Intensities

Instructions for exercise intensity were based on training guidelines recommended by the American College of Sports Medicine (1995) which require participants to exercise within a training heart rate zone of between 60% and 80% of maximum predicted heart rate using the equation $(220 - \text{age})$. The rationale for the use of training heart rate zones was explained to participants and they were asked to exercise at a level which would raise the heart rate to 70% of maximum predicted heart rate and continue at an intensity which maintained this heart rate.

Preferred Intensities

Participants were instructed how to maintain preferred exercise intensity during exercise. Instructions were based on previously used preferred intensity guidelines (Dishman et al., 1994; Parfitt et al., 2000) as follows:

“Select an exercise intensity that you prefer. This should be an intensity that you would feel happy to maintain if you were going to exercise on your own for a period of twenty minutes. The intensity should be high enough that you feel you are working, but not so high that you would never normally consider exercising at such a level. It should be an intensity that feels appropriate to you. Try to maintain a fairly consistent pace, however if you feel that you need to either slow down or speed up in order to feel comfortable, then that is fine. You are the one in control”.

Cycling

Participants were asked to pedal the cycle ergometer for twenty minutes following the required exercise intensity guidelines. A warm up / warm down protocol consisting of pedalling at 25 watts for two minutes pre and three minutes post exercise was employed. Heart rate and RPE were measured immediately prior to warm up. In addition workload, heart rate, and RPE were measured during the final 30 seconds of every 5 minute interval. Exercise self-efficacy was measured 10 minutes pre and 10 minutes post exercise in line with methods used by Rudolph and McAuley (1996). Perceived exertion was measured by holding an RPE scale at eye level and asking the participant to verbalise the perceived RPE at that point in time. At the completion of 20 minutes of cycling, participants were asked to warm down.

Walking

Participants were asked to perform a 20 minute walk around an indoor walking track measuring 70 metres in circumference, the approximate size of a basketball court. Heart rate recordings for this group were obtained by the experimenter at one of four recording stations situated around the perimeter of the walking track. RPE was measured by holding an RPE scale at eye level and asking the subject to verbalise their level of perceived exertion at that point in time. As with cycling exercise self-efficacy was measured 10 minutes pre and 10 minutes post exercise. At the completion of 20 minutes of exercise final observations for heart rate and RPE were recorded and participants were asked to walk at a slow self selected pace for a further three minutes in order to warm down.

Statistical Analyses

All recorded data was entered into Microsoft Excel and SPSS for Windows statistical package. The data was then used in producing descriptive statistics and for answering the research questions for this study. Pearson product moment correlation was used in order to determine the strength of relationship between self-efficacy and perceived exertion for experimental groups PSC, PFC, and PFW respectively. One way ANOVAs were used to test for significant within and between group differences in (a) perceived exertion, (b) change in pre to post self-efficacy and (c) heart rate for LPSC, LPFC, LPSW, and LPFW respectively.

Additional post hoc statistical techniques will be described in the results section of the respective experiments in which they were applied. Mean exercise scores for workload, heart rate and perceived exertion represent the mean of scores obtained at 5, 10, 15, and 20 minutes respectively during the course of exercise. A significance level of .05 was set in line with other research of this nature.

Reliability

A total of eight participants completed a second exercise test in order to assess the reliability of the protocols employed in the present study. Coefficient of variation (V) was calculated using methods described by MacDougall, Wenger, and Green (1991, p.76). V was below 10% for workload, heart rate, and perceived exertion recordings at minutes 5, 10, 15 and 20 of exercise respectively, with the exception of workload at minute 5 for which V was 14%. Workload V ranged from 6.5% to 14%. Heart rate V ranged from 5.4% to 7%. Perceived exertion V ranged from 3.1 to 8.5%.

CHAPTER FOUR

RESULTS

The Relationship Between Self-efficacy and Perceived Exertion

Participant Characteristics

Means (M), standard deviations (SD), and range of scores (R) for participants engaged in prescribed intensity cycle ergometer exercise (PSC), preferred intensity cycle ergometer exercise (PFC), and preferred intensity walking (PFW) are presented in Table 4.1. Participant profiles for each of the experimental groups did not differ significantly. A total of 72 individuals successfully completed their exercise assignment, each group consisting of 24 participants (12 male, 12 female).

Exercise Responses

Workload (Figure 4.1), heart rate (Figure 4.2), and perceived exertion (Figure 4.3) tended to increase across time in each of the experimental groups. In addition there was a trend towards higher workloads, heart rates, and perceptual responses to exercise for PFC than for either PSC or PFW, however differences between groups were not significant. Mean heart rate observed for PFC was 116 beats per minute (SD = 4.1) compared with 112 beats per minute (SD = .7) and 103 beats per minute (SD = 2.1) for PSC and PFW respectively (Figure 4.2). At minutes 5, 10, 15 and 20 mean heart rates recorded for PSC and PFW remained below 70% of age predicted maxima. However mean heart rates observed during the final 10 minutes of exercise for PFC were above 70% HR_{max} for this group (Figure 4.2). Mean ratings of perceived exertion values presented in Figure 4.3 corresponded to subjective ratings of “fairly light” or “moderate” on the Borg scale for

PSC (M = 10.8, SD = .3) and PFW (M = 11.3, SD = .2), and “somewhat hard” for PFC (M = 13.2, SD = .3).

Table 4.1.

Participant characteristics for PSC, PFC and PFW.

Characteristic	<u>M</u>	<u>SD</u>	<u>R</u>
	PSC (<u>n</u> = 24)		
Age (Years)	61.5	3.9	51 - 67
Body mass (Kg)	70.0	11.3	57 - 97
Sum of four skinfold (mm)	53.7	13.9	30 - 84
	PFC (<u>n</u> = 24)		
Age (Years)	62.0	4.5	51 - 70
Body mass (Kg)	72.0	12.1	55 - 98
Sum of four skinfold (mm)	56.9	12.3	40 - 83
	PFW (<u>n</u> = 24)		
Age (Years)	64.9	4.2	57 - 70
Body mass (Kg)	70.7	7.4	58 - 85
Sum of four skinfold (mm)	52.8	12.0	31 - 71

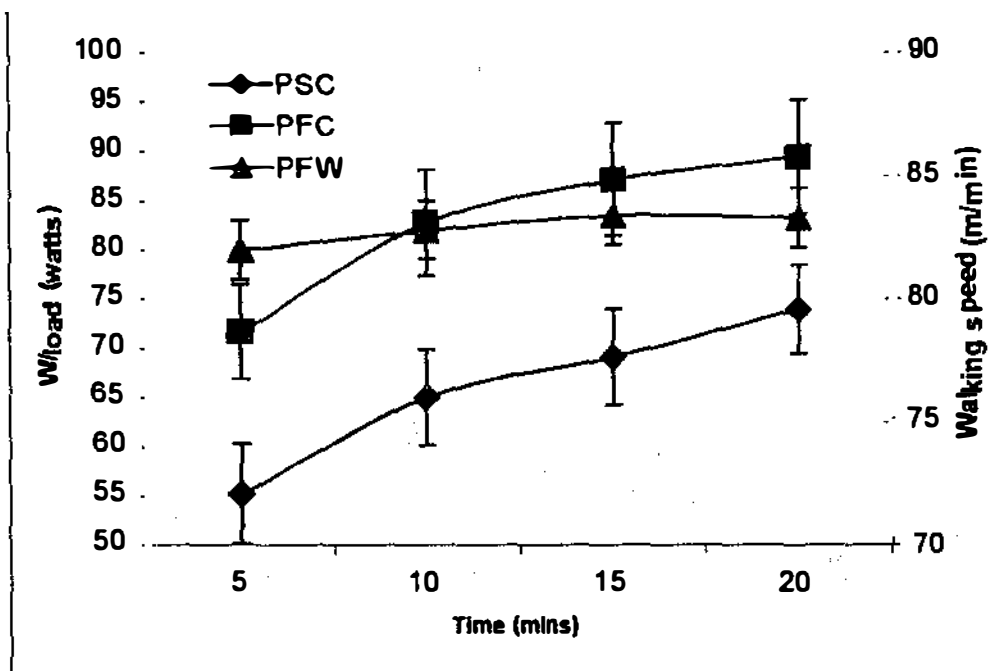


Figure 4.1. Mean workload (\pm SE) across time for PSC ($n = 24$), PFC ($n = 24$), and PFW ($n = 24$). Primary Y axis represents cycle ergometer workload (Watts). Secondary Y axis represents walking workload (metres / min).

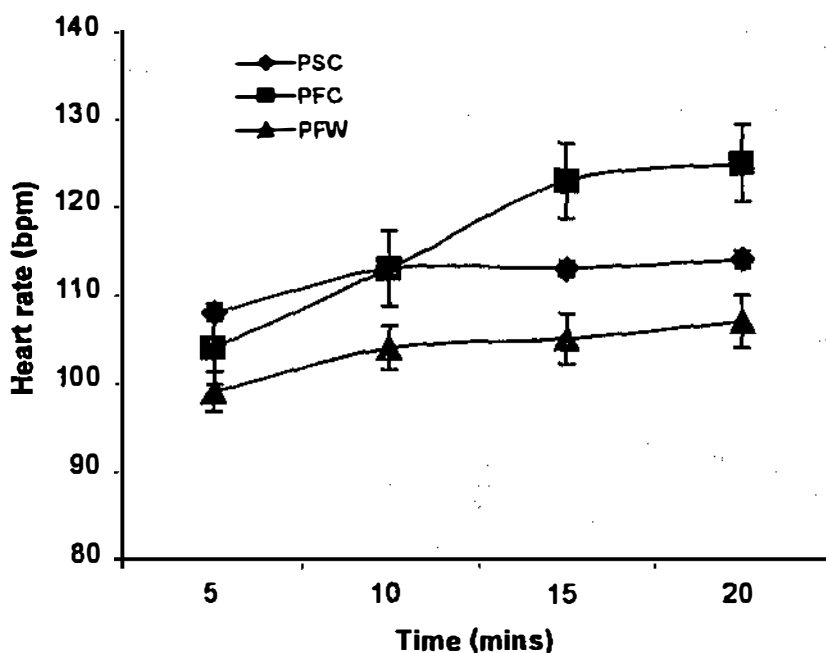


Figure 4.2. Mean Heart rate (\pm SE) across time for PSC ($n = 24$), PFC ($n = 24$), and PFW ($n = 24$).

Relationship Between Pre exercise Self-efficacy and Perceived Exertion (PSC).

Prior to the exercise protocol participants reported a wide range of beliefs in their ability to complete the required task. Following the task a significant inverse correlation ($r = -.76$, $p < .01$, Figure 4.4) was observed between pre exercise self-efficacy and perceived exertion for participants performing cycle ergometer exercise at prescribed intensities. Those individuals who were more confident in their ability prior to the commencement of the exercise task reported that the task required less effort, compared to individuals who were less confident in their own ability.

Relationship Between Perceived Exertion and Post Exercise Self-efficacy (PSC).

Participants experienced a notable increase in self-belief following completion of the exercise task, with mean self-efficacy increasing from 51.6 to 73.5 (Table 4.2). Furthermore a significant inverse correlation ($r = -.81$, $p < .01$) was observed between perceived exertion and post exercise self-efficacy (Figure 4.5). Those individuals who found that the exercise task of cycling at prescribed intensities required less effort subsequently reported higher levels of confidence in their ability upon completing the task compared to those who found that the task required a greater degree of effort.

Table 4.2.

Intercorrelations Between Physiological and Psychological Responses to Cycle Ergometer Exercise (PSC, n = 24).

Variable	M	SD	1	2	3	4	5	6
1. Self Report Exercise Score	36.9	22.8		.21	.04	-.70**	.79**	.80**
2. Mean Workload (Watts)	65.2	24.1			-.16	-.30	.42*	.17
3. Mean Heart rate (bpm)	112	3.0				.06	-.05	.15
4. Mean RPE	10.8	0.3					-.77**	-.82**
5. Pre exercise efficacy	51.6	22.7						.86**
6. Post exercise efficacy	73.5	21.7						

** indicates significant correlation ($p < .01$). * indicates significant correlation ($p < .05$).

Relationship Between Pre exercise Self-efficacy and Perceived Exertion (PFC).

Figure 4.6 shows the relationship between pre exercise self-efficacy and perceived exertion for participants engaged in cycle ergometer exercise at preferred intensities. In contrast to the findings for PSC no relationship was observed between pre exercise self-efficacy and perceived exertion ($r = -.15$, Figure 4.6). For people cycling at preferred intensities beliefs in their own exercise ability prior to the commencement of exercise had little association with feelings of physical strain reported during exercise.

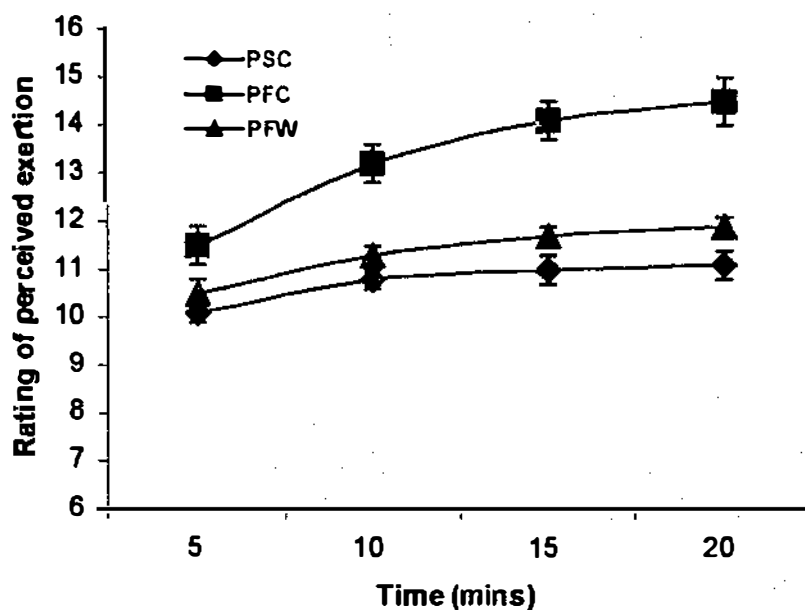


Figure 4.3. Mean Perceived exertion (\pm SE) across time for PSC ($n = 24$), PFC ($n = 24$), and PFW ($n = 24$).

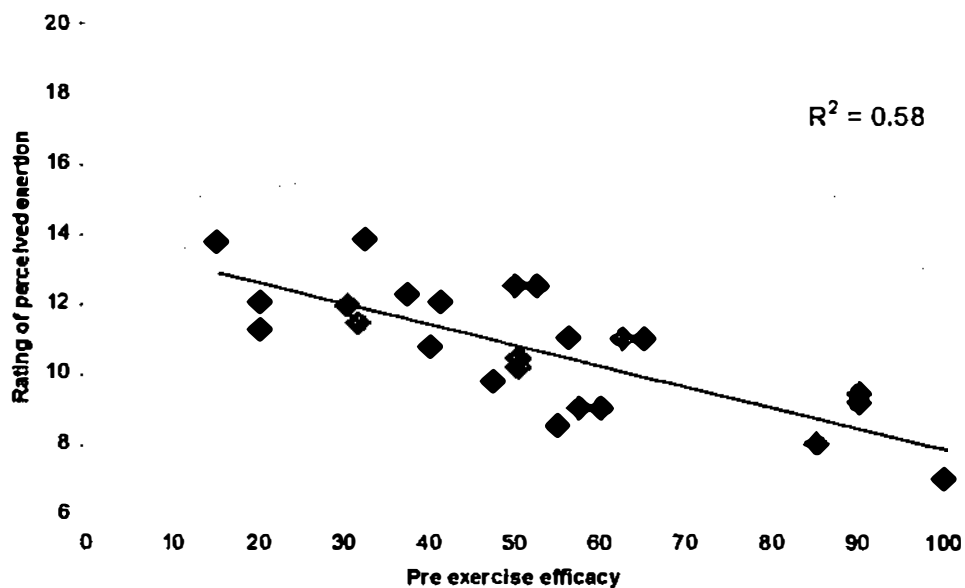


Figure 4.4. Relationship Between pre exercise Self-efficacy and perceived exertion during prescribed intensity cycle ergometer exercise (PSC, $n = 24$).

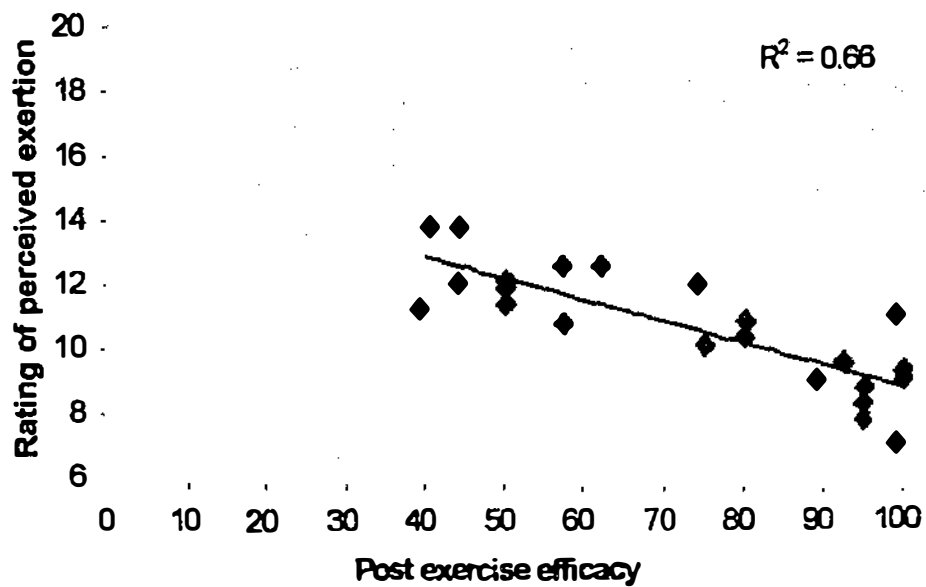


Figure 4.5. Relationship Between perceived exertion and post exercise self efficacy during prescribed intensity cycle ergometer exercise (PSC, n = 24).

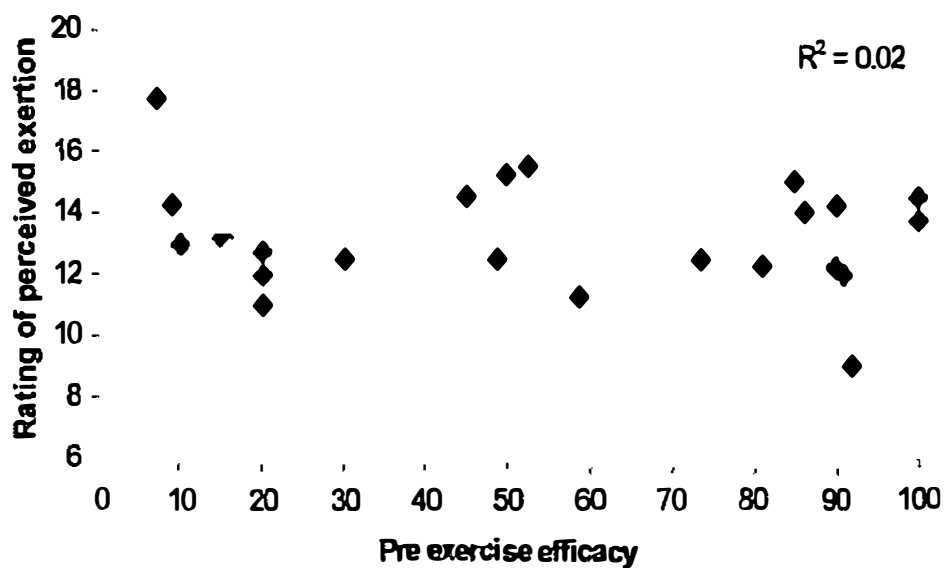


Figure 4.6. Relationship Between pre exercise Self-efficacy and perceived exertion during preferred intensity cycle ergometer exercise (PFC, n= 24).

Relationship Between Perceived Exertion and Post Exercise Self-efficacy (PFC)

No significant relationship was observed between perceived exertion and post exercise self-efficacy following preferred intensity cycle ergometer exercise ($r = -.04$, Figure 4.7). The degree to which participants perceived exercise to be fairly light, moderate, or somewhat hard on the Borg scale had little bearing on participants' self-rated belief in their exercise ability upon completion of the exercise task. Once again these results contrasted sharply with those for PSC.

Table 4.3.

Intercorrelations Between Physiological and Psychological Responses to Cycle Ergometer Exercise (PFC, $n = 24$).

Variable	<u>M</u>	<u>SD</u>	1	2	3	4	5	6
1. Self Report Exercise Score	38.6	20.9	-	.69**	.46*	.25	.63**	.70**
2. Mean Workload (Watts)	82.6	36.7		-	.67**	.28	.56**	.53**
3. Mean Heart rate (bpm)	116	20.0			-	.58**	.14	.30
4. Mean RPE	13.2	1.7				-	-.15	-.04
5. Pre exercise efficacy	53.7	33.7					-	.88**
6. Post exercise efficacy	71.0	23.0						-

** indicates significant correlation ($p < .01$). * indicates significant correlation ($p < .05$).

Relationship Between Pre exercise Self-efficacy and Perceived Exertion (PFW)

Participants generally had higher efficacy scores prior to walking at preferred intensities than cycling at either prescribed or preferred intensities. This was reflected in a trend, albeit not significant toward higher mean pre exercise self-efficacy scores for PFW (M = 66.6, SD = 22.1,

Table 4.4) compared to the other two exercise tasks. No relationship was observed between pre exercise self-efficacy for walking at preferred intensity and perceived exertion experienced while walking ($r = .29$, Figure 4.8). Participants' belief in their ability to successfully engage in exercise reported prior to the commencement of the task had little association with feelings of physical strain reported during exercise.

Relationship between Perceived Exertion and Post Exercise Self-efficacy (PFW).

Mean ratings of perceived exertion were generally lower for participants in PFW ($M = 11.3$, $SD = 1.1$, Table 4.4) than for those in PFC ($M = 13.2$, $SD = 1.7$, Table 4.3). No relationship was observed between perceived exertion and post exercise self-efficacy following walking at preferred intensities ($r = .21$, Figure 4.9). Perception of effort experienced during preferred intensity walking had little effect on participant's post exercise appraisals of their own ability.

Table 4.4.

Intercorrelations Between Physiological and Psychological Responses to Walking Exercise (PFW, n = 24).

Variable	<u>M</u>	<u>SD</u>	1	2	3	4	5	6
1. Self Report Exercise Score	39.1	23.0	-	.50*	.11	.65**	.42*	.40
2. Mean Workload (m/min)	82.9	8.1		-	-.26	.23	.21	.37
3. Mean Heart rate (bpm)	103.1	11.6			-	.52*	.48*	.35
4. MeanRPE	11.3	1.1				-	.29	.21
5. Pre exercise efficacy	66.6	22.1					-	.89**
6. Post exercise efficacy	82.2	14.4						-

** indicates significant correlation ($p < .01$). * indicates significant correlation ($p < .05$).

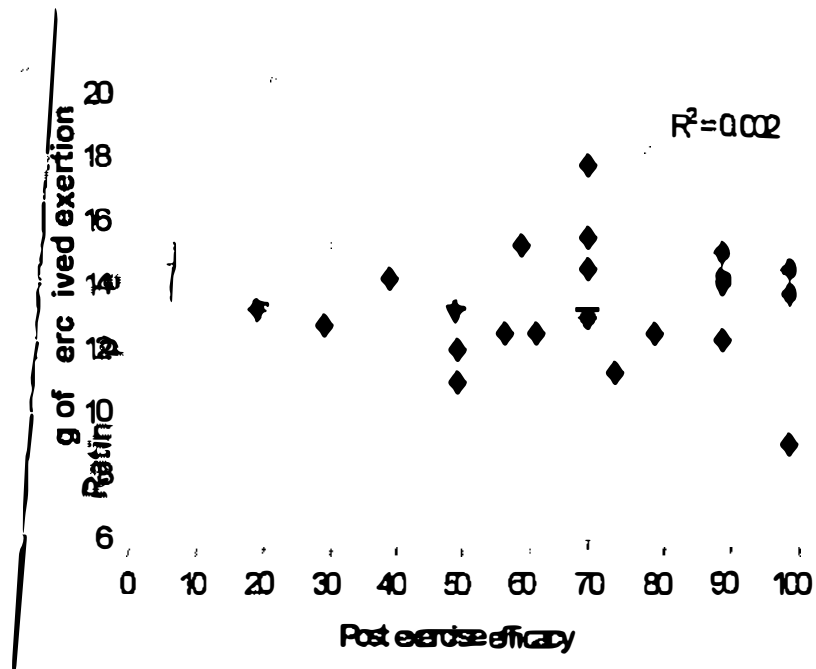


Figure 4.7. Relationship between perceived exertion and post exercise self-efficacy during preferred intensity cycle ergometer exercise (PFC, $n = 24$).

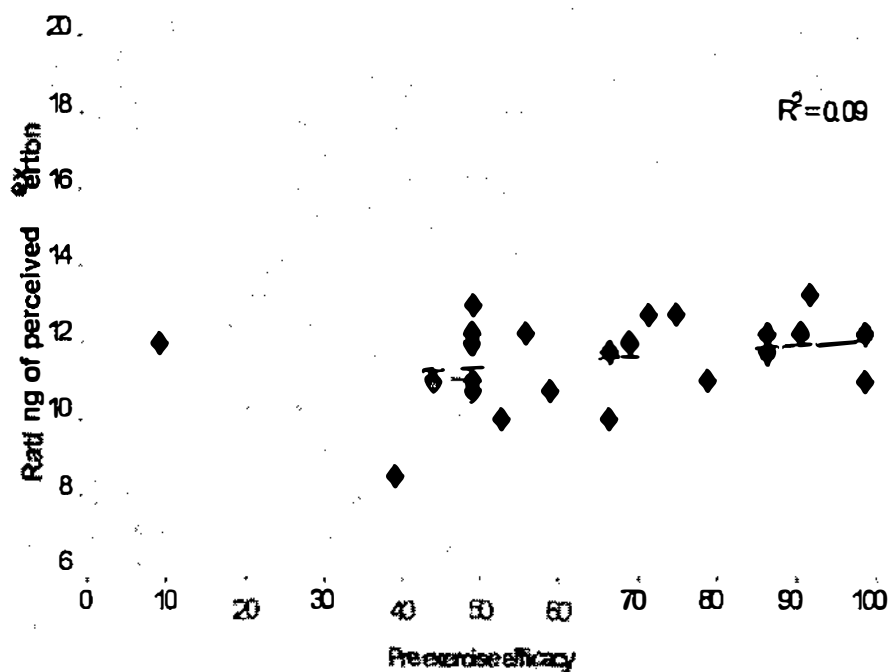


Figure 4.8. Relationship between pre exercise self-efficacy and perceived exertion during preferred intensity walking (PFW, $n = 24$).

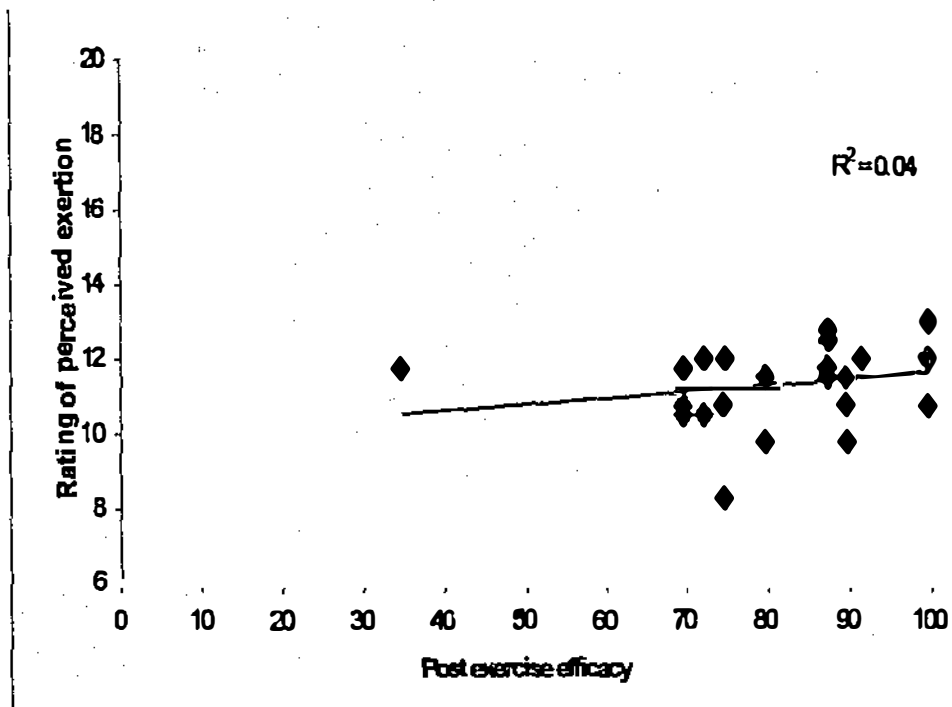


Figure 4.9. Relationship Between perceived exertion and post exercise self-efficacy during preferred intensity walking (PFW, $n = 24$).

Perceived Exertion, Self-efficacy and Heart Rate Responses

Participant Characteristics

Means (M), standard deviations (SD), and range (R) for low active participants engaged in prescribed cycle ergometer exercise (LPSC), preferred cycle ergometer exercise (LPFC), prescribed walking (LPSW), and preferred walking (LPFW) are presented in Table 4.5. Multiple analysis of variance revealed that no significant differences existed between any of the groups for age, mass, sum of four skinfolds or self-report exercise score. Physiological and psychological responses for LPSC, LPFC, LPSW, and LPFW are presented in Table 4.6.

Table 4.5.

Participant characteristics for LPSC, LPFC, LPSW and LPFW.

Characteristic	<u>M</u>	<u>SD</u>	<u>R</u>	<u>M</u>	<u>SD</u>	<u>R</u>
	LPFC (<u>n</u> = 8)			LPSC (<u>n</u> = 8)		
Age (Years)	62.1	5.7	51 - 69	63.0	5.3	51 - 67
Body mass (Kg)	76.7	13.3	62 - 98	76.2	14.2	61 - 98
Skinfold (mm)	62.8	11.5	41 - 79	58.2	14.5	39 - 84
Self report Exercise	15.4	5.0	6 - 20	16.1	5.9	3 - 20
	LPFW (<u>n</u> = 8)			LPSW (<u>n</u> = 8)		
Age (Years)	62.5	4.4	57 - 70	60.3	5.0	52 - 66
Body mass (Kg)	71.3	11.5	66 - 85	70.4	12.1	45 - 81
Skinfold (mm)	61.2	10.5	40 - 71	66.4	8.0	56 - 80
Self report Exercise	13.1	7.5	6 - 20	14.6	6.2	1 - 20

Perceived Exertion

Participants who were identified as being low active based on the self-report exercise questionnaire reported subjective responses that ranged from fairly light to somewhat hard on the Borg scale. Mean perceived exertion for low active participants performing cycle ergometer exercise at preferred intensities (LPFC) was 13.3 (SD = 1.0). Mean perceived exertion for participants engaged in cycle ergometer exercise at

prescribed intensities was 11.9 (SD = 1.4). Despite the trend toward higher ratings of perceived exertion reported by participants engaged in preferred compared to prescribed intensity cycle ergometer exercise differences between these two groups were not statistically significant. Mean perceived exertion for low active participants engaged in prescribed intensity walking (LPSW, M = 13.0, SD = 1.3) was significantly higher than for participants engaged in walking at preferred intensities (LPFW, M = 10.9, SD = 1.1) ($F(1,15) = 14.10, p < 0.01$, Table 4.6, Figure 4.10). Mean reported perceived exertion corresponded to ratings on the Borg scale of “moderate” for LPFW and “somewhat hard” for LPSW.

Self-efficacy

Participants who performed the walking tasks tended to show greater levels of pre and post exercise self-efficacy than those performing cycling tasks, these differences were not statistically significant. In addition all groups reported increases in levels of self-efficacy pre to post exercise regardless of exercise assignment. However, only pre to post exercise increases observed for LPFW were statistically significant ($F(1,15) = 37.97, p < 0.01$). Low active individuals performing cycle ergometer exercise at preferred (LPFC) experienced similar changes in pre to post exercise self-efficacy (M = 24.5, SD = 18.1) to those engaged in prescribed cycle ergometer exercise (LPSC, M = 20.7, SD = 12.1). However the magnitude of change in pre to post self-efficacy was significantly greater for LPFW (M = 21.1, SD = 9.2) than for LPSW (M = 5.9, SD = 6.0) ($F(1,15) = 15.13, p < 0.01$, Table 4.6.).

Heart Rate Responses

Participants mean heart rate responses to the four exercise conditions are presented in Figure 4.11. Mean heart rate responses were very similar for LPSC ($\underline{M} = 111.8$ bpm, $\underline{SD} = 4.8$) and LPFC ($\underline{M} = 110.4$ bpm, $\underline{SD} = 22.0$). However heart rate was significantly higher for LPSW ($\underline{M} = 114.4$ bpm, $\underline{SD} = 6.2$) compared to LPFW ($\underline{M} = 103.2$ bpm, $\underline{SD} = 5.3$) ($F(1,15) = 14.70$, $p < 0.01$). Furthermore differences were also observed between LPSW and LPFW at minute five ($F(1,15) = 10.26$, $p < 0.01$), minute ten ($F(1,15) = 10.91$, $p < 0.01$), minute fifteen ($F(1,15) = 13.41$, $p < 0.01$) and minute twenty ($F(1,15) = 11.58$, $p < 0.01$) respectively.

A total of 64 five minute heart rate recordings were obtained from low active participants engaged in preferred intensity exercise. In all 14 (21%) of 5 minute heart rate recordings fell outside a traditional recommended heart rate range (60% – 80% HRmax) during preferred intensity exercise. Of 16 participants engaged in exercise 12 maintained an intensity that fell within their target heart rate range for the duration of the exercise session. Exercise heart rates above 80% HRmax were observed at each of 5, 10, 15, and 20 minute data collection points for two participants in LPFC, indicating that these two individuals spent the duration of the task exercising at heart rates higher than those traditionally recommended for improving fitness. One participant from LPFW exercised at intensities corresponding to higher than 80% estimated HRmax during the final 10 minutes of exercise. Finally one participant in LPFW maintained an exercise intensity that fell below 60% HRmax for the duration of the exercise session.

Table 4.6.

Physiological and psychological responses for LPSC, LPFC, LPSW and LPFW.

Characteristic	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
	LPFC (<u>n</u> = 8)		LPSC (<u>n</u> = 8)	
Pre exercise efficacy	31.7	24.0	33.6	12.8
Post exercise efficacy	56.2	19.3	54.2	17.8
Change in efficacy	24.5	18.1	20.6	12.1
Mean perceived exertion	13.3	1.0	11.9	1.4
Mean heart rate	110.4	22.0	111.8	4.8
	LPFW (<u>n</u> = 8)		LPSW (<u>n</u> = 8)	
Pre exercise efficacy	64.0	6.9	55.9	24.7
Post exercise efficacy*	85.1	6.7	61.8	25.4
Change in efficacy **	21.1	9.2	5.9	6.0
Mean perceived exertion**	10.9	1.1	13.0	1.3
Mean heart rate*	103.2	5.3	114.4	6.2

- * Denotes significant differences between groups ($p < .05$).
- ** Denotes significant differences between groups ($p < .01$).

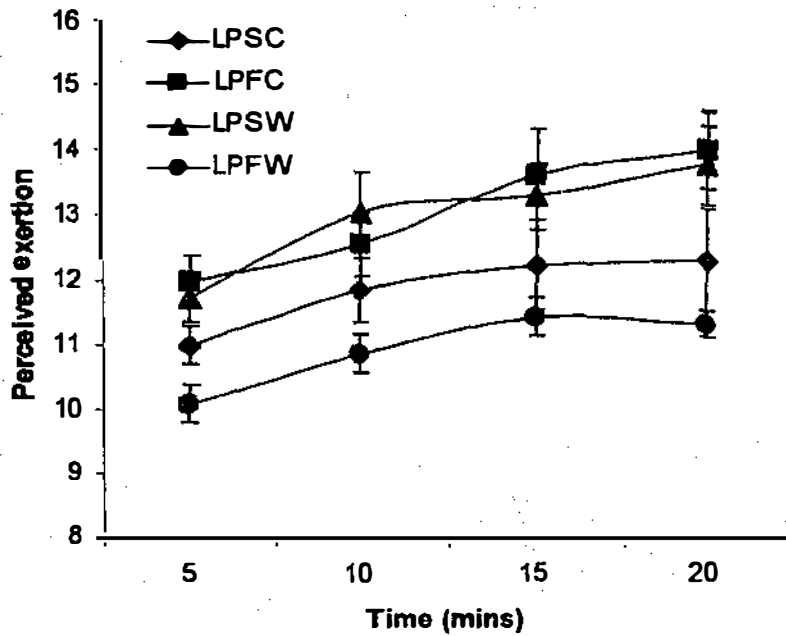


Figure 4.10. Mean perceived exertion (\pm SE) across time for LPSC ($n = 8$), LPFC ($n = 8$), LPSW ($n = 8$), and LPFW ($n = 8$)

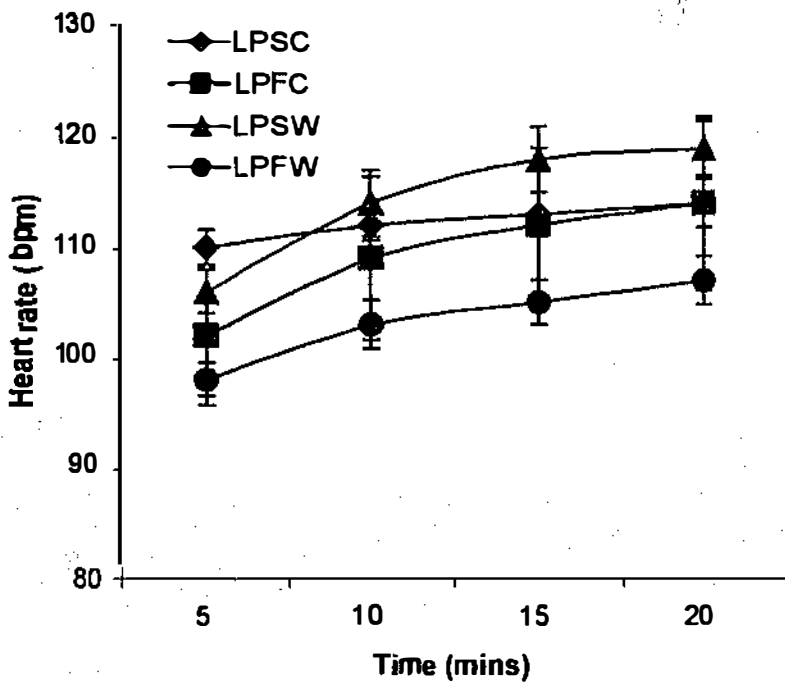


Figure 4.11. Mean heart rate (\pm SE) across time for LPSC ($n = 8$), LPFC ($n = 8$), LPSW ($n = 8$), and LPFW ($n = 8$).

CHAPTER FIVE

DISCUSSION

Introduction

The primary purpose of this study was to investigate the relationship between self-efficacy for exercise and perceived responses to an acute bout of exercise in a group of Western Australian older adults. Stemming from this purpose were two research questions. Research question one asked “does a relationship exist between self-efficacy and perceived exertion during a single bout of exercise at a prescribed intensity?” Research question two asked “does a relationship exist between self-efficacy and perceived exertion during a single bout of exercise at a preferred intensity?” A relationship was found to exist between self-efficacy and perceived exertion during prescribed but not preferred intensity exercise. These represent original findings, as there is no known research that has investigated these relationships during continuous exercise in older participants at either prescribed or preferred intensities.

A secondary purpose of study was to observe perceived exertion, magnitude of change in pre to post exercise self-efficacy and heart rate responses to acute preferred and prescribed intensity exercise in low active older participants. This purpose was addressed by research questions three, four, and five respectively. Research question three asked “do low active participants engaged in a bout of cycle ergometer exercise at a preferred intensity report lower levels of perceived exertion and favourable changes in pre to post exercise self-efficacy than participants engaged in cycle ergometer exercise at a prescribed

intensity?" No significant differences were observed for either perceived exertion or change in pre to post exercise self-efficacy participants engaged in cycle ergometer exercise, irrespective of the exercise intensity guidelines employed.

Research question four asked "do low active participants engaged in a bout of walking at a preferred intensity report lower levels of perceived exertion and favourable changes in pre to post exercise self-efficacy than participants engaged in walking exercise at a prescribed intensity?" Individuals engaged in a bout of walking at preferred intensities reported lower levels of perceived exertion and greater magnitude of change in pre to post exercise self-efficacy than those who walked at prescribed intensities.

Research question five asked "do low active participants engaged in a bout of exercise at preferred intensities experience heart rate responses which fall within a recommended heart rate training range?" The majority of participants engaged in preferred intensity exercise in this study selected heart rates that fell within a recommended heart rate training range. The purpose of the remainder of this chapter is to consider the practical implications of the findings relating to each of the research questions.

Relationship Between Self-efficacy and Perceived Exertion (Prescribed Intensities)

An inverse relationship was found to exist between pre exercise self-efficacy and perceived exertion ($r = -.77$, $p < .01$). In addition an even stronger relationship was observed between perceived exertion and post exercise self-efficacy ($r = -.82$, $p < .01$).

Therefore the findings of the present study support the existence of a relationship between self-efficacy and perceived exertion during a single bout of cycle ergometer at prescribed intensities.

The strength of the relationships between the study variables was similar to those previously reported (Rudolph & McAuley, 1996). However the findings contrast with those obtained from earlier research in a sample of older participants employing the same exercise mode (McAuley & Courneya, 1992), in which a poor correlation between self-efficacy and perception of effort was observed. Rudolph and McAuley (1996) suggested that failure to adequately control for participant fitness levels by employing estimates might have contributed to the lack of a strong relationship between self-efficacy and perceived exertion in the earlier study. A strong correlation was observed in the present study, despite the fact that relative fitness levels were also based on estimates, in this case obtained from self-report exercise participation. Variability in the physiological and psychological responses associated with the different protocols may have contributed to the lack of correspondence between findings of the studies.

McAuley & Courneya (1992) required participants to complete an incremental exercise test that was terminated upon reaching 70% of predicted maximum heart rate (time to reach this point averaged approximately seven minutes). In the present study, as well as that conducted by Rudolph and McAuley (1996) participants engaged in continuous exercise for twenty minutes at 70% of age predicted maximum heart.

Evidence suggests that the cumulative effects of progressive increments in intensity during a graded exercise test result in higher perceived exertion at a given workload than during continuous exercise, due to differences in the rate at which exertional cues accumulate (Van Den Burg & Deci, 1986). Perceived exertion is also influenced by exercise duration, with reduced effort being associated with exercise of twenty minutes duration, compared with that of shorter duration, probably resulting from greater use of dissociation strategies during the course of a longer bout of exercise (Rejeski & Ribisl, 1980). Lower mean RPE observed in the present study compared to that of McAuley and Courneya despite the employment of the same exercise intensity for both groups might reflect differences in exercise responses resulting from participation in differing exercise protocols.

It can be argued that, based on the relationship between self-efficacy and perceived exertion, lower levels of perceived exertion reported by participants in the present study compared to those observed by McAuley and Courneya (1992) should have resulted in greater increases in post exercise self-efficacy. In fact, levels of post exercise self-efficacy were similar for participants in both of these studies. There are a number of possible reasons to explain these discrepancies. Firstly McAuley and Courneya (1992) administered a walk / jog self-efficacy questionnaire despite the fact that cycle ergometry was used in their study. Furthermore activity levels of their participants were not reported. These issues seem to confound the ability to draw meaningful conclusions between this aspect of the two studies.

A significant inverse correlation ($r = -.70$, $p < .01$) was also observed between self-report exercise score and perceived exertion. Those people who did not engage in regular exercise (based on self-report exercise scores) experienced greater levels of perceived effort associated with acute exercise at 70% HR_{max} than their more active counterparts. These findings are consistent with Demello et al. (1987) who reported that trained participants experienced reduced RPE compared to untrained participants at exercise intensities ranging from moderate to near maximal. Such a phenomenon possibly occurs as a result of enhanced respiratory and metabolic physiological adaptation for exercise in trained individuals (Carton & Rhodes, 1985; Robertson, 1982). Therefore the relationship between self-report exercise score and perceived exertion observed in the present study suggests that the research strategy employed was successful in identifying individuals who differed in perceptual responses to a given exercise stimulus.

Relationship Between Self-efficacy and Perceived Exertion (Preferred Intensities)

In contrast to the findings for prescribed intensity exercise no significant relationship was observed between self-efficacy and perceived exertion during either walking or cycling at a preferred intensity. During preferred intensity exercise lack of belief in exercise ability was not associated with heightened perceptions of physical strain experienced during exercise. In addition higher perceptions of effort were not associated with reduced post exercise estimates of ability. These findings suggest that preferred intensity guidelines might be useful for buffering the impact of potentially aversive aspects of exercise such as high levels of perceived effort in low active individuals.

Post hoc analysis also revealed a significant trend towards higher mean perceived exertion for PFC compared to PSC. Participants perceived that cycle ergometer exercise at preferred compared to prescribed intensities required greater effort. It has previously been stated that those higher in existing self-efficacy are more likely to set challenging goals when given the opportunity to direct activities. Indeed higher levels of physical strain can lead to increases in these individuals' degree of endeavour and motivation for future attempts while optimising physical benefits of exercise (Bandura, 1997; Parfitt et al., 2000). Therefore the higher levels of perceived exertion resulting from preferred intensity cycle ergometer exercise might have positive implications for high active and / or highly efficacious individuals.

From a theoretical perspective, the findings of this study appear to reflect the model of somatic interpretation proposed by Cioffi (1991). Cioffi proposed that a wide range of factors, including existing personal beliefs, the demands of certain tasks, and environmental conditions, interact to influence acute responses to an activity. The design of the present study did not allow for in-depth analysis of the interaction of all of these variables. However it is proposed by this author that differences existed in the nature of the interaction between an important somatic label (perceived exertion), and existing attitudes and beliefs (including level of self-efficacy) during tasks that differed in their context (preferred compared to prescribed exercise). Furthermore it is proposed that these differences were reflected in the strength of the relationship observed between self-efficacy and perceived exertion during for the two exercise tasks.

As was the case with cycling no relationship was observed between self-efficacy and perceived exertion for participants engaged in walking at preferred intensities. In addition there was a trend toward higher levels of pre exercise self-efficacy for PFW compared to the other exercise conditions. Finally mean levels of perceived exertion for PFW tended to be lower than for PFC. These findings taken together suggest that although the dissociation of the relationship between self-efficacy and perceived exertion during preferred intensity exercise is not mode dependent, the benefits resulting from this phenomenon for less active individuals might be. Self-efficacy theory suggests that for less efficacious, low active individuals exercise tasks that instil greater levels of self-belief and reduce perceived strain during exercise, are far more likely to encourage on-going participation (Bandura, 1997). Therefore it appears from the findings of this study that preferred intensity walking might represent a favourable alternative for bolstering self-efficacy prior to exercise and reducing perceived exertion experienced during exercise compared to cycle ergometry at either prescribed or preferred intensities.

Mean heart rates observed for both PFC and PFW fell within a range approximating 60 – 80% HRmax and were consistent with heart rate responses previously reported to result in improvements in physiological parameters of fitness when maintained consistently across the course of an exercise program. For instance DeVries (1971) observed that participation in a six week walk / jog exercise program at between 60 – 80% HRR resulted in improvements in aerobic capacity, measured by a sub-maximal graded exercise test, in over 70% of participants aged 60 – 79 years. Similarly Badenhop, Cleary, Schaal, Fox, and Bartels (1983) found that a nine week exercise program at intensities ranging between 30-45% HRR were adequate for eliciting improvements in VO₂ max in groups of people aged

60 and above. The current findings therefore provide support for the effectiveness of exercise at preferred intensities for eliciting physiological responses likely to result in improvements in cardiovascular fitness.

Responses to Prescribed and Preferred Intensity Exercise (Low Active Individuals)

In the present study mean perceived exertion reported by low active participants was significantly lower during walking at preferred compared to prescribed intensities. In addition, change in pre to post exercise self-efficacy was significantly greater for those participants walking at preferred, than those walking at prescribed intensities. These observations suggest that preferred intensity walking represents a simple and effective alternative for low active participants attempting to build confidence in their own exercise ability. In addition weight bearing exercise such as walking has benefits for reducing the impact of age related decline in important health-related factors such as bone mineral density (Holloway, 1998), and has been reported as the preferred choice of exercise by many older people (Booth et al., 1995).

In contrast no differences were observed for perceived exertion or magnitude of change in pre to post exercise self-efficacy reported by low active participants engaged in cycle ergometer exercise at preferred compared to prescribed intensities. These findings appear to confirm those obtained from PFC and PFW that practical benefits associated with preferred intensity exercise in terms of reducing perceived effort and increasing self-efficacy might be mode dependant.

For some older individuals however, walking for exercise does not present a practical exercise choice. Wear and tear associated with aging such as musculoskeletal deterioration makes weight bearing exercise requiring ambulation difficult for some people (Bar-or et al., 1972). Personal safety is also a consideration when planning outdoor activities as crime against older people in public places becomes increasingly common. Exercise on a stationary cycle represents a form of exercise that can be completed within the home. Therefore despite the fact that in the present study cycle ergometer exercise at preferred compared to prescribed intensities did not result in any greater reductions in perceived exertion and increases in pre to post exercise self-efficacy, riding a stationary cycle at a self-selected intensity still offers a simple alternative for those who find outdoor exercise difficult, and struggle to acquire the skill of monitoring heart rate during exercise.

The *moderate* to *somewhat hard* perceptual ratings observed for walking at preferred intensities were consistent with previous findings. Moderate relative metabolic and perceptual intensities have been associated with exercise at preferred levels of exertion in both young and older populations and groups differing in fitness level (Bar-Or et al., 1972; Dishman et al., 1994; Farrell et al., 1982). Therefore the present findings provide support to existing literature that moderate perceptual intensities are chosen by people asked to select an exercise intensity that they prefer.

However higher exercise intensities were observed in participants performing preferred compared to prescribed cycle ergometer exercise. This finding corresponds with those of Parfitt et al. (2000). Interestingly the same was not the case for walking. Hetzler and colleagues (1991) studied the effects of exercise modality on absolute and relative

metabolic responses to exercise in young untrained males. They found that given blood lactate concentrations were observed in the working muscles at lower heart rates during cycle ergometer compared to treadmill exercise (Hetzler et al., 1991). In a further study Baldwin et al. (2000) compared physiological responses to relative exercise intensities in trained and untrained males of similar age. These researchers found that heart rates as well as blood lactate concentrations were higher at given percentages of maximal exercise capacity in untrained compared to trained individuals.

It is proposed that in the present study perceptual signals reported to be dominated by blood lactate concentration during cycle ergometer exercise (Astrand & Rodahl, 1977; Ekblom & Goldbarg, 1977) accumulated more rapidly for the cycle group compared to those participating in walking. Based on the findings of Baldwin and colleagues (2000), low active participants such as those in the present study would have been particularly susceptible to the onset of metabolic stress during the exercise task due to reduced physiological adaptation compared to more active participants. Individuals cycling at preferred intensities may not have possessed the adequate combination of physiology and / or movement skills required to effectively maintain a lower level of perceived effort, compared to low active individuals performing the more familiar activity, walking.

In the present study 13 of 16 participants, engaged in either preferred intensity cycling or walking experienced heart rate responses that fell within a target heart rate training range for the entire exercise bout. Therefore the present findings suggest that for healthy older adults exercise at preferred intensities represents a safe method of monitoring exercise intensity. Chow and Wilmore (1984) studied the pattern of heart rate responses at

regular intervals throughout the course of an exercise bout similar to the one employed in the present study. They found that although the mean exercise heart rate fell within a training range, there was considerable variability in individual heart rate readings to the extent that 33% fell outside and 25% considerably above a recommended heart rate training intensity. Possible explanations for differences in the findings of the present study and that of Chow and Wilmore relate to methodological factors, namely differences in sample age, duration of exercise, and treadmill versus free walking.

As low active individuals generally exhibit a greater number of cardiovascular risk factors than more active people (Fox, Bowers & Foss, 1989) the findings within the present sample are particularly salient for less active members of the community who possess higher levels of body fat and are heavier than their contemporaries. For this group relatively poor health status and poor exercise skills represent a potentially dangerous combination of factors. Therefore the safety benefits of exercise at preferred intensities should provide reassurance to people in this group.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

The findings of the present study suggest that a relationship exists between self-efficacy and perceived exertion during exercise at prescribed intensities. They also indicate that the strength of the relationship between these two variables can be manipulated by altering the exercise environment, in this case, the method of self-monitoring exercise intensity. These findings suggest paths for future research.

As previously stated a number of important interactions relating to aspects of self-efficacy, perceived exertion, physical activity, and exercise undoubtedly contributed in part to responses observed in the present study. Given the complex nature of such relationships the task of establishing causal order and the relative contribution of these interactions was well beyond the aims and objectives of this research. Studies aimed at establishing the relative contribution of a range of personal, situational, and environmental factors that result in acute exercise responses are therefore suggested. In addition, based on the current findings the cognitive-perceptual model of somatic interpretation proposed by Cioffi (1991) appears to hold the potential for providing a useful framework on which to base such research.

Investigations of this nature have the potential to provide information that would allow exercise professionals to more accurately match an individual's existing beliefs and

abilities with appropriate exercise alternatives, thus maximising positive aspects of acute exercise, and ultimately increasing the probability of on-going participation.

The present findings also suggest that for low active older people, walking at preferred intensities elicit acute responses less likely to result in aversive exercise experiences than walking at prescribed intensities. In addition exercise at preferred intensities may be of great value for encouraging individuals who already possess high levels of self-efficacy to pursue challenging goals, reap maximum physiological benefits from exercise participation and maintain motivation to participate. That higher levels of perceived exertion were not associated with negative effects on self-efficacy during preferred intensity cycle ergometer exercise suggests that when choice of exercise mode is limited, allowing less active individuals to select an intensity they prefer may help to attenuate the impact of negative exercise responses. However this aspect of the findings needs to be confirmed across a range of exercise modes. Exercise at preferred intensities appears likely to result in improvements in physiological functioning when maintained over the course of an exercise regimen. However it is important to note that a limitation of this study was that only responses to acute bouts of exercise were examined. Therefore extrapolation of any long-term benefits needs to be executed with caution. Longitudinal studies are needed in order to confirm this. Finally, it is also concluded that in healthy older populations this method of self-monitoring exercise intensity is safe.

In sum, the present findings support the use of preferred intensity guidelines, increasingly adopted by health agencies, as a simple, safe, and effective method of minimising negative aspects of exercise, and promoting acute responses likely to encourage

older people to adopt and maintain an active lifestyle. The findings provide further scientific evidence as to the potential benefits of emerging methods of presenting exercise to participants. They also serve as a reminder that people differ widely in their responses to varying exercise situations, and that these differences need to be carefully considered if strategies aimed at increasing participation in exercise and physical activity are to be successful.

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APPENDIX A

National Physical Activity Guidelines

NATIONAL PHYSICAL ACTIVITY GUIDELINES FOR AUSTRALIANS

The guidelines refer to the minimum levels of physical activity required for good health. They are not intended for high level fitness or sports training.

Try to carry out all guidelines and *for best results combine an active lifestyle with healthy eating.*



think of movement as an opportunity, not an inconvenience.



be active every day in as many ways as you can.



put together at least 30 minutes of moderate-intensity physical activity on most, preferably all, days.



if you can, also enjoy some regular, vigorous exercise for extra health and fitness.

NATIONAL PHYSICAL ACTIVITY GUIDELINES

Guidelines



Where any form of movement of the body is seen as an opportunity for improving health, not as a time-wasting inconvenience.

Think of movement as an opportunity, not an inconvenience

Movement in modern times

The technology of today has reduced much of the need for human movement. Cars now reduce the need for walking. Machines carry out heavy work for us. Home entertainment such as TVs, videos and computers keep us inactive for long periods of time.

The need for even small amounts of movement or physical activity in the course of our daily lives has been reduced. For example, the effort required changing channels on TV, or to open the garage door has been eliminated for many by the use of remote control technology. The effort of washing dishes and clothes has been replaced by the automatic dishwasher and clothes washing machines. Even the need to move to communicate has been reduced by the hand-held telephone and electronic mail (e-mail) in the office.

The need for movement

All of these changes have come upon us gradually, almost unnoticed, with advances in technology. Yet the human body was designed to move. Through hundreds of thousands of years of evolution, humans have been active in the process of survival-hunting, gathering or farming food, collecting fuel and participating in manufacture and commerce.

Decreases in activity in society have been associated with an increase in obesity and other health problems. Without awareness of these problems, humans have begun to enthusiastically embrace the benefits of machines and to consider 'unnecessary' movement as an inconvenience. This is combined with our social attitudes that the more appliances we have to do things for us, the more successful we are.

Changing our mind-set about movement

Underlying all education about increased physical activity for health must be a change in our attitude towards movement. If all movement is regarded as an opportunity to improve health rather than as a time-wasting inconvenience, the benefits of modern technology can be enjoyed without the negative health consequences.

Put together at least 30 minutes of moderate-intensity physical activity on most, preferably all, days



Moderate-intensity activity includes things such as a brisk walk or cycling. Combine short sessions of different activities of around 10 to 15 minutes each to a total of 30 minutes or more. The 30 minutes total need not be continuous.

Moderate-intensity activity doesn't have to be continuous

In the past, it was thought that for exercise to be beneficial, it had to be carried out vigorously, 3 to 4 days a week for a minimum of 30 minutes. However, a review of exercise research has shown that this only applies to increases in physical fitness. Improvements in indicators of health - such as blood pressure, blood cholesterol and body weight - can result from putting together shorter amounts of moderate-intensity activities totalling a minimum of 30 minutes a day on most days, or doing 30 minutes continuously.

Moderate-intensity activity will cause a slight, but noticeable, increase in breathing and heart rate. A good example of moderate-intensity activity is brisk walking at a pace where you are able to comfortably talk but not sing. Other examples include mowing the lawn, digging in the garden, or medium-paced swimming or cycling.

Moderate-intensity activity should be carried out for a minimum of around 10 minutes at a time without stopping. The 30 minutes total can be achieved through one, or a combination of activities such as parking the car further away from a destination and walking briskly, getting off a bus before the final stop, or active play with children. It can also be achieved through combining activities such as cycling, brisk walking, dancing or swimming for 30 minutes, or carrying out any of these for at least 10 minutes each for a total of 30 minutes or more.

It is important to remember that the 30 minutes total need not be continuous.

Combining activity with family, community or social life

To provide positive benefits, and to be enjoyable and sustainable, the activity, or combined activities designed to total at least 30 minutes per day, can be part of work, family, community or social life. Putting together 30 minutes of moderate-intensity activity will add to the health benefits of being more active every day.

FOR AUSTRALIANS

Be active every day in as many ways as you can



Make a habit of walking or cycling instead of using the car, or do things yourself instead of using labour-saving machines.

The health benefits of becoming more active

The increase in effort-saving technology in modern societies has coincided with increasingly busy lifestyles. Hence, we not only have less need to be active, but seem to have less time. However, it is possible to regain some of the health benefits of regular movement through being more active in everyday life.

Recent research has shown that even the most inactive or sedentary people can gain health benefits if they become even slightly more active. Based on these findings, governments around the world have now identified increased physical activity as a priority in improving the health of their populations.



Ways of increasing activity

Small increases in daily activity can come from small changes carried out throughout the day. For example, making a habit of walking or cycling instead of driving or riding in a car; doing some gardening; walking up stairs instead of using the lift or an escalator; and/or doing things by hand instead of using labour-saving machines. All these things can add to the level of daily physical activity. It is important to remember that some activity is better than none, and more is better than a little.

Being and thinking active

Being active in lots of little ways throughout the day, combined with an attitude that regards all forms of physical activity as an opportunity to improve our health, will help increase the amount of physical activity we carry out and improve our well-being. Being active in small ways is likely to provide health advantages to almost all people, irrespective of age, body weight, health condition or disability.



If you can, also enjoy some regular, vigorous activity for extra health and fitness



Vigorous exercise makes you 'huff and puff'. For best results, this should be added to the above guidelines on 3-4 days a week for 30 minutes or more each time.

Vigorous activity and fitness gains

This guideline does not replace earlier recommendations to put together 30 minutes of physical activity on most days. It adds an extra level to this recommendation for those adults who are able and who wish to achieve greater health and fitness benefits. **Children and teenagers under the age of 18 should follow this guideline routinely.**

Research has shown that able-bodied people can get added health and fitness benefits (beyond those achieved through increasing daily movement or regular moderate-intensity activity), by carrying out some regular vigorous exercise. These benefits include extra protection against heart disease. Vigorous exercise will also help to improve fitness and sports performance in activities requiring a high level of energy use.

How hard is vigorous?

'Vigorous' implies activity, which makes you 'huff and puff', and where talking in full sentences between breaths is difficult. In technical terms this is exercise at a heart rate of 70-85% of maximum heart rate (MHR), where MHR is calculated as 220 minus your age. Vigorous exercise can come from active sports such as football, squash, netball and basketball, and activities such as aerobics, circuit training, speed walking, jogging, fast cycling or brisk rowing. For best results, this type of activity should be carried out for a minimum of around 30 minutes on 3 to 4 days a week.

Seeking medical advice

Although there's no age barrier to carrying out vigorous activity, medical advice is recommended for those who have been previously inactive, who have heart disease, or close relatives with heart disease, or who have other major health problems. Vigorous activity in pregnancy is not recommended without strict medical supervision.

Warm-up, cool-down, stretching and a gradual build-up from an inactive level are also recommended with vigorous exercise, in line with most recommended fitness training programs.

About the Guidelines

The physical activity guidelines for Australians have been developed through extensive consultations with a wide range of experts in physical activity¹. They incorporate recent thinking about physical activity for health², in addition to the more widely understood concepts of exercise³ for fitness⁴.

Guidelines 1 to 3 stress the importance of all forms of movement⁵, including moderate-intensity physical activity⁶, particularly in those who are currently inactive. Guideline 4 illustrates the added health and fitness benefits which can be gained from higher levels of physical activity or exercise. The guidelines refer to the minimum level of physical activity required for the attainment of good health and a healthy body weight. They are not meant for high level fitness or sport training. They also do not include the warm-up, cool-down and stretching requirements of more vigorous sports or exercise.

For best results, the guidelines should be combined with an ongoing pattern of healthy eating. In general, this means eating a wide variety of foods including plenty of breads and cereals (preferably wholegrain), vegetables (including legumes) and fruits. It also involves choosing foods which are low in fat, particularly saturated fat, and also low in salt. Only a moderate amount of sugars and foods containing added sugar should be chosen, and for those who drink alcohol, it should be done in moderation.

Dietary Guidelines for Australians can be obtained from government departments of health or community health centres.

Definitions

For the purpose of this document the following definitions have been adopted:

- 1 *Physical activity* refers to any activity that involves significant movement of the body or limbs.
- 2 *Health*, in this instance, refers to metabolic well-being as reflected in low risk levels of blood fats, blood pressure and body weight as well as general physical and mental well-being.
- 3 *Exercise* is a type of physical activity defined as a planned, structured and repetitive body movement done to improve or maintain physical fitness.
- 4 *Fitness* relates to the capacity of the heart and lungs to supply oxygen-rich blood to the working muscles and the capacity of the muscles to use oxygen to produce the energy for movement.
- 5 *Movement* is defined here as any motion of the body and limbs.
- 6 *Moderate-intensity physical activity* will cause a slight, but noticeable, increase in breathing and heart rate and may cause light sweating in some people.

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For more information about the guidelines and how to get started call

1800 020 103

and ask for the PHD publications requestline

Developed by the University of Western Australia and the Centre for Health Promotion and Research Sydney, for the Commonwealth Department of Health and Aged Care



APPENDIX B

Health Risk Questionnaire

Pre Test questionnaire

Personal details

Name

Age

D of B

Gender

Address

Contact phone numbers

Occupation

Employer

Emergency contact number

Regular physician

Medical

1. Has your doctor ever said that you have heart trouble ?
2. Do you frequently have pains in your heart or chest region?
3. Do you often feel faint or have severe dizzy spells?
4. Has your doctor ever told you that your blood pressure is too high and that you may have a problem with your blood pressure?
5. Do you have any bone or joint problems such as arthritis or an old sporting injury which you or your doctor think may be made worse if you exercise? Please list
6. Have you ever suffered from a stroke?
7. Are you male and over 35 years or female and over 45 years?
8. Is there any other medical or health reason that you can think of which would prevent you from undertaking a fitness evaluation and increasing your physical activity? Please list
9. Do you take any medication which you or your doctor think may affect our fitness measurements or affect you during or after a fitness evaluation or during an exercise programme?
10. Are you on any medication at all at the moment?

PERSONAL DETAIL SHEET

Yes, I am interested in participating in a research study aimed at finding ways to make it easier for people to begin and maintain regular exercise as part of a healthy lifestyle. I understand that by providing these details I am under no obligation to participate in the study and that if I do choose to participate I am free to withdraw at any time and for whatever reason.

NAME:..... SUBURB.....

CONTACT TELEPHONE AND CONVENIENT CONTACT TIME.....

AGE..... HEIGHT (APPROX.)..... BODY WEIGHT (APPROX.).....

Please complete the following record of your average weekly exercise participation. This refers to specific exercise such as walking and fitness classes as opposed to incidental exercise during shopping, work around the house etc. Circle the number closest to the correct response. Thankyou.

Frequency	5	Daily or almost daily
	4	3 to 5 times per week
	3	1 to 2 times per week
	2	A few times per month
	1	Less than once per month
Intensity	5	Sustained heavy breathing and perspiration (extremely hard)
	4	Heavy breathing and perspiration (moderate to hard)
	3	Moderately heavy-breathing as in brisk walking (moderate)
	2	Moderately heavy breathing as in casual walking (light/moderate)
	1	Very easy as in stretching (light)
Time	4	Over 30 min
	3	20 to 30 min
	2	10 to 20 min
	1	Under .10.min

APPENDIX D

Self-efficacy Scales

NAME _____

ID _____

Please indicate below how confident you are that you can successfully carry out each of the activities listed below

I BELIEVE THAT I CAN RIDE THE EXERCISE BIKE:

For 5 minutes at a moderately fast pace selected by myself without stopping

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

For 10 minutes at a moderately fast pace selected by myself without stopping

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

For 15 minutes at a moderately fast pace selected by myself without stopping

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

For 20 minutes at a moderately fast pace selected by myself without stopping

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

For 25 minutes at a moderately fast pace selected by myself without stopping

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

For 30 minutes at a moderately fast pace selected by myself without stopping

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

For 35 minutes at a moderately fast pace selected by myself without stopping

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

For 40 minutes at a moderately fast pace selected by myself without stopping

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

NAME _____

ID _____

Please indicate below how confident you are that you can successfully carry out each of the activities listed below.

I BELIEVE THAT I CAN WALK:

For 5 minutes within my heart rate training zone without stopping

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

For 10 minutes within my heart rate training zone without stopping

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

For 15 minutes within my heart rate training zone without stopping

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

For 20 minutes within my heart rate training zone without stopping

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

For 25 minutes within my heart rate training zone without stopping

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

For 30 minutes within my heart rate training zone without stopping

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

For 35 minutes within my heart rate training zone without stopping

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

For 40 minutes within my heart rate training zone without stopping

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

NAME _____

11)

Please indicate below how confident you are that you can successfully carry out each of the activities listed below.

I BELIEVE THAT I CAN WALK:

For 5 minutes at a moderate fast pace selected by myself without stopping

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

For 10 minutes at a moderate fast pace selected by myself without stopping

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

For 15 minutes at a moderate fast pace selected by myself without stopping

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

For 20 minutes at a moderate fast pace selected by myself without stopping

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

For 25 minutes at a moderate fast pace selected by myself without stopping

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

For 30 minutes at a moderate fast pace selected by myself without stopping

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

For 35 minutes at a moderate fast pace selected by myself without stopping

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

For 40 minutes at a moderate fast pace selected by myself without stopping

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

NAME _____

ID _____

Please indicate below how confident you are that you can successfully carry out each of the activities listed below

I BELIEVE THAT I CAN RIDE THE EXERCISE BIKE:

For 5 minutes within my heart rate training zone without stopping

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

For 10 minutes within my heart rate training zone without stopping

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

For 15 minutes within my heart rate training zone without stopping

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

For 20 minutes within my heart rate training zone without stopping

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

For 25 minutes within my heart rate training zone without stopping

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

For 30 minutes within my heart rate training zone without stopping

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

For 35 minutes within my heart rate training zone without stopping

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

For 40 minutes within my heart rate training zone without stopping

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

APPENDIX E

Perceived Exertion Scale

THE BORG 15 POINT SCALE FOR RATINGS OF PERCEIVED EXERTION, THE RPE SCALE

Score	Subjective Rating
6	
7	Very very light
8	
9	Fairly light
10	
11	Moderate
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very very hard
20	

Based on: Borg G (1985, p.26). An Introduction To Borg's R.P.E. Scale.

Michigan. Mouvement Publications

APPENDIX F

Instructions For Estimating Perceived Exertion

Appendix F

A standard set of instructions based on those suggested by Borg (1985) was used to guide subjects as to how to evaluate feelings of strain during exercise. Subjects were advised that an RPE of six represented minimal work as might be experienced when sitting quietly prior to exercise. An RPE of 8-9 represented a workload similar, to perhaps, slow walking. 10-12 would represent an effort equivalent to a brisk walk or a light jog. 13-15 represented a level of effort similar to, perhaps a moderate run. That is to say that although the workload feels reasonably difficult, it can still be maintained for some time. 16-18 should represent a workload that is quite hard such that it could not be maintained for an extended period of time. 18-20 represent maximal effort levels (as hard as can be imagined) that cannot be maintained for more than a very short time. It was then explained to subjects that central RPE referred to feelings of exertion coming from the chest ie. heart and lungs, and that local RPE referred to feelings of exertion coming from the legs. It was stressed to participants that they should take their time and be honest and attempt to appraise RPE as correctly as possible.

APPENDIX G

Participant Handout / Written Consent

INFORMED CONSENT FOR VOLUNTARY PARTICIPATION IN:

A RESEARCH STUDY EXAMINING THE ROLE OF SELF-EFFICACY AND PERCEIVED EXERTION DURING EXERCISE AT VARYING INTENSITIES FOR PEOPLE OVER FIFTY YEARS OF AGE.

Introduction

Participation in regular exercise has been cited as an important pursuit for maintaining health and physical function across the lifespan (Palmore, 1970). A physically active lifestyle has the potential to maintain and promote health, prevent disease (Blair, Paffenbarger, Clark, Cooper & Gibbons, 1989) and maintain one's independence well into old age (Greendale, Barrett-Connor, Edelstein, Ingles & Haile, 1995). Unfortunately people over 50 years of age are over represented in that section of the total population which does not engage in sufficient exercise on a regular basis (Owen & Bauman, 1992). Therefore exploring methods of encouraging people to maintain an active lifestyle represents important research.

Subjective ratings of perceived exertion is a subjective measure of exercise intensity based on feelings of strain on the part of the subject. The concept of measuring feelings of exertion has recently been applied to exercise settings in the wider community. Self-efficacy has been defined as "people's beliefs about their abilities to exercise control over events which affect their lives" (Bandura, 1977). Self-efficacy has been posited as a particularly important influence on the success or failure of initial attempts to incorporate

levels of Self-efficacy coupled with heightened perception of effort during acute bouts of exercise might ultimately discourage exercise participation. However this suggestion remains largely unresolved to a lack of research studies which have examined the relationship between these factors.

Purposes of the study

The purpose of this study was to study the relationship between Self-efficacy and perceived exertion during various types and intensities of exercise.

Procedures

Participants will be asked to perform a 20 minute exercise session consisting of either walking around an indoor track or cycling on an exercise cycle at moderate exercise intensities. A variety of physiological and psychological responses will be measured prior to, during , and after completion of the exercise session.

Time requirements

Participation in the study will require approximately one hour to complete. Times will be arranged to suit the participant.

Possible benefits of participation in the study

The development of safe, simple and appropriate methods of prescribing and monitoring exercise intensity is important for encouraging healthy exercise habits both for individuals and groups within the community.

Ethics

The highest ethical standards will be maintained throughout the course of the study. In order to maintain the confidentiality each participant will be assigned a number which will be used in place of their name throughout the course of the study. In addition the study has the approval of the Edith Cowan ethics committee.

Withdrawal from the study

Any person who chooses to participate in the study is free to withdraw from the study at any time and for any reason. There is no obligation to continue and no penalty whatsoever for withdrawal.

Questions

Any questions regarding any of the issues or procedures discussed in this handout can be directed in the first instance to:

Keith Scotson	Student Researcher	Tel: 9438 2823
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Dr. Paul Sacco	Principal Researcher	Tel: 9400 5642
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REFERENCES

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INFORMED CONSENT

I..... Have read the information supplied in this handout and have had any questions regarding my involvement in the study answered to my satisfaction. I agree to participate in the study on the understanding that I may withdraw at any time without penalty of any kind

In addition I agree that any research data gathered throughout the course of the study may be published provided my anonymity is assured.

.....

Date

Participant

.....

Date

Researcher

INSTRUCTIONS FOR PARTICIPANTS

Your participation in this study is greatly appreciated. The results obtained during the study can be affected by certain factors and so it would be greatly appreciated if you would follow some simple guidelines in the days leading up to the testing sessions.

1/. Try to consume as close to your "normal" diet in the two days prior to a testing day as possible.

2/. Try to avoid moderate to heavy exercise in the two days prior to a testing day.

3/. Try to avoid excessive alcohol intake the day prior to a testing day.

4/. Please inform the researcher prior to testing if any of the above criteria were not met.

Again, thank you for your participation in this study. By following the guidelines explained on this page results obtained during the study will have greater validity and will ensure that your time contribution provides valuable data.