Predicted and Actual Exercise Discomfort, Self-Efficacy and Enjoyment in Middle School Children: A Match-Mismatch Paradigm

by

Irene Kane

B.S., University of Pittsburgh, 1974

B.S.N., Pennsylvania State University, 1979

M.S.N., University of Pittsburgh, 1980

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This dissertation was presented by

Irene Kane

It was defended on

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and approved by

Dr. Robert J. Robertson, Professor and Dissertation Advisor,

Department of Health and Physical Activity

Dr. Deborah J. Aaron, Associate Professor, Department of Health and Physical Activity

Dr. Carl I. Fertman, Associate Professor, Department of Health and Physical Activity

Dr. Wendell R. McConnaha, Clinical Faculty, Director, Falk Laboratory School

Dr. Elizabeth F. Nagle, Assistant Professor, Department of Health and Physical Activity

Dr. Bruce S. Rabin, Professor, Department of Pathology and Psychiatry

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Irene Kane, PhD

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PURPOSE: The purpose of this study was to use a match-mismatch paradigm to examine three psychological constructs that potentially influence children's beliefs about participation in an aerobic physical activity: *exercise discomfort, self-efficacy, and enjoyment.* **METHODS**: Thirty-four middle school females (n =18) and males (n = 16) aged 11-14 years completed the: 1) Exercise Discomfort Index (Children's OMNI Perceived Exertion (RPE) Scale x Children's OMNI Perceived Muscle Hurt (RMH) Scale; 2 Exercise Self-Efficacy Scale: Running; and, 3) Physical Activity Enjoyment Scale. Measurements were obtained prior to and following performance of the nationally standardized PACER (Progressive Aerobic Cardiovascular Endurance Run) field test of aerobic fitness. **RESULTS:** Dependent t-tests for the total (p = .009) and female (p = .042) groups indicated that predicted was greater than actual exercise discomfort; while for the male (p = .057) group predicted and actual exercise discomfort did not differ. Idiographic analysis showed that overpredictors of discomfort reported less time engaged in recreational activity than underpredictors. Exercise self-efficacy was greater (p < .001) pre-, than post-exercise for both male and female children. Exercise enjoyment was the same (p = .400) pre-, and post-exercise for both male and female children. Pearson correlation coefficients for interrelations between exercise discomfort, self-efficacy and enjoyment were not significant with the exception of a significant relation (r = .302) between post-exercise self-efficacy and post-exercise enjoyment. A significant relation was observed between PACER laps completed and pre-, (r = .582) and post- (r = .703) exercise self-efficacy, but not between PACER laps completed and discomfort or enjoyment. **CONCLUSION**: Employing a match-mismatch experimental paradigm suggested that exercise discomfort, self-efficacy and enjoyment were psychological constructs that may influence children's beliefs about an aerobic physical activity. It is possible that one or more of these psychological constructs plays an important role in the initiation and maintenance of aerobic exercise. Such findings can in turn inform physical activity interventions and/or innovative health-fitness components of Physical Education curricula intended to promote cardiovascular health and fitness through regular participation in aerobic physical activity.

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PREFACE

The author gratefully acknowledges the time and dedication of Dr. Robert J. Robertson, Dissertation Advisor throughout this research investigation. Gratitude is extended to my Dissertation Committee members for their support and guidance: Dr. Deborah J. Aaron, Dr. Carl I. Fertman, Dr. William R. McConnaha, Dr. Elizabeth F. Nagle, and Dr. Bruce S. Rabin and to my statistical consultant, Dr. Elaine N. Rubinstein. A special thank you is given to Ms. Laura A. Hunt, Falk School Physical Education teacher, for her collaboration and organizational skills. Finally, the ongoing encouragement and optimism of my husband, Kevin, and my children, Kevin, Sean and Kyra have been most appreciated.

1.0 INTRODUCTION

The health enhancing effects of physical activity for youth are increasingly documented (5, 7, 14, 35, 102, 137, 172). The Centers for Disease Control and Prevention define and distinguish between physical activity, exercise, and physical fitness as follows: physical activity is ‘any bodily movement produced by skeletal muscles that results in energy expenditure; exercise is a subset of physical activity that is planned, structured, and repetitive’ to improve or maintain physical fitness which is ‘a set of attributes that are either health or skill related’ (33, 34).

Physical activity has been recognized for its positive influence on the health of youth. However, three consistent conclusions were drawn from a review of international youth physical activity surveys (162). These surveys concluded that American children and adolescents are not sufficiently active; girls are less active than boys; and activity participation declines during adolescence, with less than 50% of adolescents sufficiently active. In a study of 1200 students, grades 5-11, Petosa reported that only 15% of children participated regularly in aerobic activity (128). The 1996 Surgeon General’s Report noted that ‘physical activity dramatically declines with age during adolescence’ (172). In fact, Aaron et al. reported a 26% decline in physical activity participation in their study of 782 adolescents (1). Their findings called for further research ‘identifying factors influencing participation in specific physical activities'. Understanding those factors that determine children's physical activity behavior is critical to reversing the inactivity crisis in our nation's youth (16, 35, 41, 50, 52, 101, 171).

Barriers or impediments to exercise activity are described as 1) actual, such as lack of physical resources, e.g. equipment, or 2) perceived, as in how we feel, e.g. exercise induced fatigue (28). Although no one variable can be expected to account for a child's physical activity behavior, Sallis et al. identified 'perceived barriers' as the most consistent psychological factor correlating with children's level of physical activity participation (155). Research suggests a strong connection between personal beliefs about physical activity and actual participation in a physical activity (13, 45, 132, 167). Examining perceived barriers to discern their potential impact on actual physical activity participation is cited as most effective when the barriers are 1) 'cast within a theoretical framework with accurate measurement and interpretation' and, 2) related to a 'specific type of physical activity' (28, 30, 155-156).

In the present investigation, three psychological constructs that potentially operate as barriers to influence children's beliefs about participation in an aerobic physical activity were examined: a) exercise discomfort defined as perceived exertion and muscle pain/hurt; b) exercise self-efficacy; and, c) physical activity enjoyment. Awareness of the influence of these constructs on a child's physical activity behavior provided useful insights in the development of interventions to diminish the physical inactivity crisis.

1.1 RATIONALE

1.1.1 Perception of Exercise Discomfort: Exertion and Muscle Hurt

Exertional perceptions are formed from psychological and biological interactions that occur during physical activity performance (23). Biddle and Mutrie proposed a psychobiological model with 'exercise intensity identified as the most obvious physical parameter of exercise likely to affect perceptions of the experience' (23).

Exertional perception, defined as 'the feelings of effort, strain, discomfort, and fatigue' expected or experienced during exercise, is described by Robertson as a 'complex psychological process' influenced by physiological, psychological, cognitive, and social/situational mediators (143, 144). The perception of exertion experienced during aerobic and resistance exercise has been examined extensively for children and adults (144). Comparatively higher levels of perceived exertion experienced at a given physiological reference point may be a psychological barrier to physical activity participation. It is speculated that these comparatively higher perceived exertion levels can subsequently influence physical activity adoption and adherence. Further study was necessary to determine the role that exertional perceptions play in shaping children's 'perceived barriers' to participation in aerobic exercise of varying intensity (23, 28, 144, 155).

Limited research has focused on the perception of naturally occurring skeletal muscle pain as a possible barrier to participation in both aerobic and resistance exercise. Neuromuscular pain is generally described as an 'unpleasant sensation associated with actual or potential tissue damage' (144). Since 'the word hurt is understood by children as young as three years old', it was the descriptor of choice in the present investigation to define exercise-induced skeletal muscle pain in children (181, 183).

O'Connor and Cook unequivocally concluded that naturally occurring muscle pain with exercise is a critical factor in determining exercise performance (37, 122). However, they described exercise pain as 'widely recognized, but poorly understood'. Rachman and Arntz, building upon a long-standing psychological model from the study of aversive stimuli, employed 'a match-mismatch paradigm' in their efforts to understand painful experiences (135). Using this cognitive appraisal paradigm, individuals were asked to predict the pain expected with natural (exercise) and contrived (shock) experiences. Following the experiences the individual reported the actual pain that occurred. Correct predictions matched the actual reports. Incorrect predictions were labeled mismatches with an overprediction greater than or an underprediction less than the actual experience. In general, individuals 'overpredict the pain they will experience' (135).

From these findings it was logical to theorize that naturally occurring skeletal muscle pain/hurt potentially played an aversive role in the adoption and performance of physical activity by children. Available evidence suggested that exercise induced muscle pain/hurt is distinct from, but may interplay with exertional perceptions (37, 144). The interplay of perceived exertion and muscle hurt were critical factors influencing perceived exercise discomfort associated with the intensity and duration of an exercise bout (27, 37, 43, 78, 144).

Evidence for this postulate was supported in a study by Poulton et al. examining cognitive appraisal of predicted and actual perceptions of discomfort for adults performing cycle exercise (132). Although discomfort was not explicitly defined in this study, pre-exercise predictions of discomfort ("How much discomfort do you anticipate experiencing?") were compared with post-exercise reports. Overprediction of discomfort was correlated with lower levels of time engaged in physical activity. The authors concluded that 'cognitive processes and attitudes occurring in close proximity to physical exercise were important correlates of health behaviors'. They advocated 'studying specific thought processes and attitudes in close temporal proximity to physical activity to understand factors that lead to the uptake and maintenance of a physically active lifestyle' (132).

The present study was an initial step toward: 1) understanding the interactive role that perceived exertion and muscle hurt played in forming an index of exercise discomfort; and 2) employing the match-mismatch paradigm to study predicted and actual exercise discomfort perceived by middle school children performing the PACER aerobic shuttle run. Examining perceived exertion and muscle hurt as components of exercise discomfort followed Poulton's suggestion to study factors 'in close temporal proximity to a physical activity that may influence initiation and maintenance of participation in a physical activity' (132). Employing the match-mismatch paradigm to explore predicted and actual exertion and muscle hurt as physical activity barriers had not been investigated in either child or adult samples. The perception of exertion and muscle hurt were examined using the Children's OMNI Scale of Perceived Exertion (144) and the Children's OMNI Scale of Muscle Hurt (145). These scales were administered prior to and following the PACER shuttle run. Potentially unique findings from the study of perceptual discomfort increased understanding of cognitive appraisal processes operating as a psychological barrier to aerobic exercise participation in middle school youth (132, 136, 180). Insight about such perceptual processes has been deemed critical to 'minimizing negative exercise experiences' potentially contributing to children's inactivity (132, 171-172).

1.1.2 Exercise Self-Efficacy

If exercise discomfort operated as a barrier in children's personal beliefs about physical activity, then an important key was knowledge of how children's perceptions of exercise discomfort evolved. Operative cognitive processes offered insight to understand how positive and negative perceptions played into beliefs that formulate a child's personal expectations or predictions about physical activity (11, 20-21, 29, 40, 140-141, 166).

Social cognitive theory (SCT) proposes that exercise self-efficacy, one's believed exercise capability, is a potential mediator of an individual's perception and interpretation of the exercise experience (11-13, 51, 83, 126-127, 163). In one study of ethnically diverse male and female sixth graders, Trost et al. found that exercise self-efficacy was a 'clear predictor of objectively measured moderate and vigorous physical activity' in girls; and was 'a salient predictor of both moderate and vigorous physical activity in boys' (167). McAuley and Blissmer summarily described exercise self-efficacy as a 'significant predictor' of exercise adoption and maintenance from youth to the elderly adult (106). On the other hand, Sallis et al. reviewed multiple youth studies on factors influencing physical activity and found that self-efficacy had an 'indeterminate relation with children's physical activity' and 'should be subjected to more detailed study' (155-156).

The above discrepancy in study findings was postulated to be influenced by the relation between exercise efficacy expectations with psychological constructs such as perceived exertion and enjoyment (104). McAuley and Courneya reported that a successful or unsuccessful exercise performance resulted in respectively a positive or negative experience that contributed to subsequent exercise efficacy expectations (104). Additionally, previous reports described exercise self-efficacy as dependent upon the specific task and situation (13, 30). As Buckworth and Dishman explained, an Olympic soccer player will not have the same efficacy expectation on the basketball court (30).

A logical next step was to use a match-mismatch paradigm to study the possible interaction between exercise discomfort and exercise self-efficacy. In this context, self-efficacy was recognized as a cognitive factor that is both a 'determinant and consequence' of exercise participation (30, 103). Following Buckworth and Dishman's reasoning, the 'task specific' exercise used in the present investigation was the commonly used PACER shuttle run (30, 111). Previous studies did not employ a match-mismatch paradigm to examine a discomfort, (i.e. exertion/hurt) model that recognized a mediating role of exercise self-efficacy. The combination of exertion and hurt as dual perceptual barriers were speculated to represent a potentially powerful influence on the formation of a child's beliefs to exert 'behavioral control over the exercise event', i.e., exercise self-efficacy (12, 19, 21-22, 150).

1.1.3 Exercise Enjoyment

The Florida alliance for successful physical education programs for children states—"The primary reason children cite for participating in sports and physical activity is "fun" (75). Dishman et al. noted that enjoyment is an 'understudied mediator' for children's activity interventions (54). Yet, enjoyment of physical activity has been tied to a child's physical activity experiences and associated beliefs about skills. Robbins et al. pointed out that 'pleasurable experiences are critical to increasing physical activity self-efficacy and subsequent frequency of the activity' (141-142).

Exploration of exercise self-efficacy from the perspective of adolescent girls' enjoyment of physical activity revealed a positive association between enjoyment and belief in exercise ability (54). In a study with adults, McAuley and Courneya found that enjoyment was associated with higher exercise self-efficacy (104). Further research with mixed gender groups of children was recommended to gain greater understanding about how physical activity enjoyment and self-efficacy influence physical activity behavior (54, 104).

Examining physical activity enjoyment in conjunction with exercise self-efficacy using validated questionnaires provided further insight into the complex cognitive appraisal process operating immediately prior to and following aerobic exercise in middle school youth (142). In the present study, a match-mismatch paradigm was used to examine pre- and post enjoyment and self-efficacy and the influence of these psychological constructs on predicted and actual perceived exercise discomfort during an aerobic exercise performance. Exploring young children's experience of exercise discomfort, exercise self-efficacy and exercise enjoyment contributed knowledge that can be used to prevent lifelong avoidance of physical activity with its concomitant loss of health benefits (1, 7, 75, 132, 168, 172, 177). Findings suggested innovative approaches to children's exercise programs to address these psychological constructs. As Poulton et al. observed, 'public health campaigns aimed at non-threatening, attractive, and rewarding everyday physical activity are needed' (132).

1.2 DEFINITION OF TERMS

- Exercise discomfort: subjective rating of perceived exertion and muscle hurt during aerobic exercise of increasing intensity
- Perceived exertion: 'how tired the child's body feels' during the PACER (144)

- Perceived muscle hurt: 'the amount or intensity of hurt that the child feels in their leg muscles' during the PACER (145)
- Exercise self- efficacy: the belief in one's ability to perform aerobic exercise (30, 106)
- Physical activity enjoyment: enjoyment defined as 'fun' during exercise (54, 75, 77)
- Match-mismatch paradigm: comparison of predicted and actual measures of discomfort, efficacy and enjoyment involving the PACER shuttle run (132, 135)
- Aerobic exercise performance: the 'planned' and 'structured' performance of a task specific aerobic exercise, i.e., the PACER (Progressive Aerobic Cardiovascular Endurance Run) shuttle run, a submaximal aerobic field exercise (18, 28, 30, 93, 111)

1.3 SUMMARY

The current study proposed a match-mismatch paradigm to examine exercise discomfort, self-efficacy and enjoyment as potential physical activity barriers that operate in a complex cognitive appraisal process during aerobic exercise (Figure 1). Investigation of these combined psychological barriers employed an exercise-specific stimulus (PACER) with middle school children.

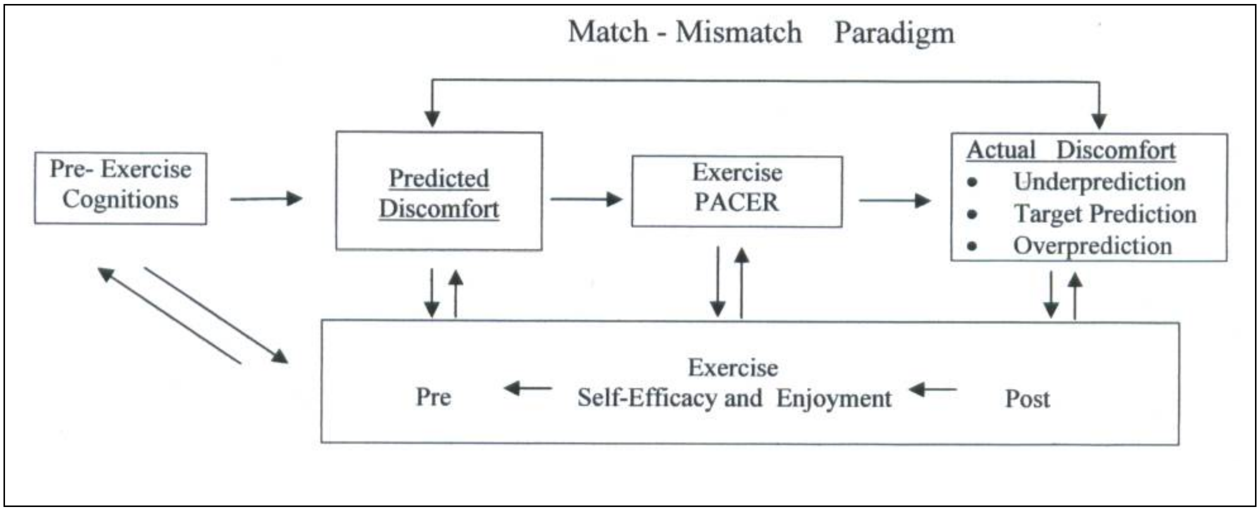


Figure 1: Match-Mismatch Paradigm: Exercise Discomfort, Self-Efficacy, Enjoyment

Given this theoretical rationale, the following research purposes and hypotheses were explored:

1.4 RESEARCH PURPOSES AND HYPOTHESES

I. This investigation used a match-mismatch paradigm to study the differences between predicted and actual exercise discomfort (exertion/hurt), and pre-, and post-exercise self-efficacy and enjoyment in a sample of 11-14 year old female and male children performing an aerobic shuttle run of increasing intensity, i.e., the PACER.

It was hypothesized that for female and male 11-14 year old children performing the PACER:

1. Predicted exercise discomfort would be greater than actual exercise discomfort.
2. Pre-exercise self-efficacy would be less than post-exercise self-efficacy.
3. Pre-exercise enjoyment would be less than post-exercise enjoyment.

II. The interrelations between predicted and actual exercise discomfort, pre-post self-efficacy and enjoyment were examined in a sample of 11-14 year old female and male children performing an aerobic activity of increasing intensity, i.e., the PACER.

It was hypothesized that for female and male 11-14 year old children performing the PACER:

1. Predicted exercise discomfort would be negatively correlated with pre-exercise self-efficacy and enjoyment.

2. Actual exercise discomfort would be negatively correlated with post-exercise self-efficacy and enjoyment.

III. The interrelations among the six variables (predicted and actual ratings of exercise discomfort, pre-, and post-exercise self-efficacy and enjoyment) and selected demographic variables were examined in addition to those considered in Hypothesis II in a sample of 11-14 year old children performing the PACER.

2.0 REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

There is a "call to action" to reverse the physical inactivity crisis of American children. Stephens observed, 'children living in the United States are less active and more obese than ever before' (161). Equally important to implementing programs that increase children's participation in physical activity is an understanding of the 'psychological process or change variables underlying the targeted outcome' (85). This understanding is necessary to ensure an accurate 'applied psychology knowledge base' in promoting physical activity participation (85). The processes that promote a child's physical activity participation are a subject of continuing research seeking to enhance the success of long-term interventional strategies (44, 47-49, 56, 124-125, 137, 164).

The purpose of this review was to explore predicted and actual exercise discomfort (exertion and muscle hurt),pre-, and post-exercise self-efficacy and enjoyment as psychological constructs underlying physical activity participation. Specifically, this review presented a theoretical and empirical foundation for the investigation. It postulated that the constructs of exercise discomfort, self-efficacy and enjoyment were perceived barriers that operated through a match-mismatch paradigm in middle school children performing a task specific aerobic physical activity. Databases searched electronically to conduct this review included: PITT*Cat*, OVID Medline, Psych Info, Health and Psychosocial Instruments, Scopus, Expanded

Academic ASAP, Google Scholar, ERIC, Health Source, Academic Search Premier and Pub Med.

2.2 PERCEIVED BARRIERS

Perception is defined by Webster as the 'act of apprehending with the mind or the senses' and a barrier as 'something in the way, a hindrance to approach or progress' (175). Perceptual barriers related to involvement in physical activity have been described as 'perceived impediments to action' (28).

Numerous studies with children have identified selected factors termed perceived barriers to physical activity participation (17, 32, 45, 66, 155, 165). Such barriers 'become predictors within data-driven models or are identified as determinants in surveys' (28, 153, 156). They have been described according to multiple domains: biological/physiological (e.g. genetic influence, aerobic fitness, exercise intensity, etc.), psychological (exertion, self-efficacy, motivation, intention, enjoyment, etc.), environmental (weather, equipment, location, etc.), social/cultural (parent/peer support, ethnicity, socioeconomic status, etc.) or demographic (age, gender, education, etc.) (23, 28, 32, 44, 153, 184). These factors are hypothesized to affect the adoption and maintenance of physical activity. Perceptual barriers fall within the psychological domain. Sallis et al. reported that perceived barriers for both boys and girls were inversely correlated with the level of their physical activity participation (153-156).

A consistent research message has been the need to better understand how perceptual barriers influence youth's physical activity participation (22, 29, 47, 125, 127, 156, 164). Brawley et al. summarized that 'efforts must be made to understand the psychology of perceived barriers if we expect to make advances toward facilitating greater involvement in physical activity' (28). The study of these influential factors requires theoretically grounded, explicit measurement of the 'extent to which the barrier limits exercise behavior' for a *specific time and type* of physical activity (28). Thus, the exact activity frame of reference must be known by the exercising individual in order to report perceived barriers such as discomfort, self-efficacy or enjoyment (28, 30). In this study, the PACER shuttle run was identified as the 'specific' aerobic physical activity.

2.3 PERCEPTION OF EXERCISE DISCOMFORT: EXERTION AND MUSCLE HURT

2.3.1 Introduction

In the context of this investigation exercise discomfort was defined as the intensity of perceived exertion and muscular hurt (exertion/hurt). The reliability, validity, and application of these discomfort measurements during aerobic exercise were considered in this section.

2.3.2 Perception of Physical Exertion

One determinant described as influential in physical activity participation in children and pertinent to research within all age groups is exercise intensity (23, 25, 119, 141-144, 155). The perception of exertion varies positively with exercise intensity and is described within the psychological domain as a major factor correlated with exercise behavior (23, 25, 50, 69, 112-114, 119, 141, 143-144).

The study of 'effort sense' (i.e. perceived exertion) can be traced to the late 1800's and early 1900's within the scientific field of psychophysics (119-120). In general, psychophysics focuses on 'the study of the human perceptual response' (119, 144). The psychophysiological examination of perceived exertion during exercise, 'the human ability to detect and interpret bodily sensations during physical activity', has been increasingly studied since the late 1950's, and early 1960's (119-120, 143-144). Gunnar Borg, known as the father of the concept of perceived exertion, was the first scientist to examine the psychophysiological nature of this construct and his early work has generated a continuing flow of scientific research (25-27, 58, 99-100, 112-114, 119-120, 144, 146-148).

A theoretical premise at the core of perceived exertion is that physiological responses to exercise, (e.g., heart rate, ventilation, oxygen consumption, lactic acid), shape the intensity of perceptual signals (25-27, 62-63, 119, 144). As the intensity of the exercise performance increases, 'corresponding and interdependent changes occur in both the perceptual and physiological processes' (144). Thus, the subjective response to exercise 'involves physiological, perceptual and performance effort continua' as depicted by Borg's Effort Continua Model (Figure 2) (26, 144).

EFFORT CONTINUA MODEL

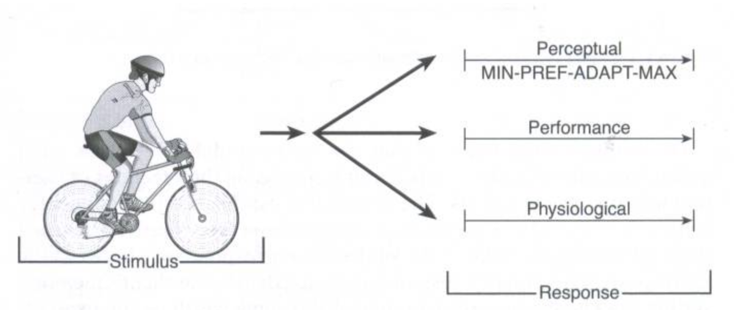


Figure 1.2 Effort continua model of perceived exertion. Min = minimum; Pref = preferred; Adapt = adaptation; Max = maximum.

Figure 2: Borg's Effort Continua Model

From R. J. Robertson (2004) Percieved Exertion for Practitioners: Rating Effort with the Omni Picture System; Champagne, IL: Human Kinetics, p.3 (144).

Exertional perceptions and physiological requirements of exercise are believed to be interdependent processes that occur in conjunction with actual exercise performance (144). Since the inception of Borg's Effort Continua Model, numerous studies and composite reviews have noted a correlation between physiologic and perceptual responses during dynamic exercise in both adults and children (57, 62, 78, 119-120, 143-144, 146-148, 173). Therefore, perceived exertion can be used to provide subjective information regarding exercise tolerance that closely ties to the physiological response.

However, as Robertson notes, perception of exertion is a 'complex psychological process' which may be influenced by a range of physiological and psychological mediators as well as exertional symptoms (144). Physiological mediators include respiratory-metabolic (e.g. pulmonary ventilation, oxygen uptake, heart rate), peripheral (e.g. metabolic acidosis, blood glucose, muscle fiber type) and non-specific (hormonal and temperature regulation) factors that contribute to the exertion perceived during aerobic and/or resistance exercise (78, 119, 143-144). Psychological and social mediators are classified into four groups (Figure 3) (144).

Exertional symptoms such as fatigue, aches, muscular or articular pain are believed to be related to both physiological and psychological mediators (144).

Classification	Factor
Emotion or mood	Anxiety Depression Extroversion Neuroticism
Cognitive function	Dissociation Self-efficacy Type A personality
Perceptual process	Pain tolerance Sensory augmentation or reduction Somatic perception
Social or situational	Music Sex of counselor Social setting

Figure 3: Psychosocial Mediators of Perceived Exertion

From R. J. Robertson (2004) Perceived Exertion for Practitioners: Rating Effort with the OMNI Picture System. Champagne, IL: Human Kinetics, p. 7 (144).

Robertson reports that although research has shown that psychological mediators 'account for inter-individual differences in perceived exertion', further study is needed in this domain to improve understanding of the how these factors actually mediate the intensity of the perceptual signal (144). Biddle and Mutrie concur as they relate that about '30 per cent of the variance between perceived exertion and physiological parameters remains unexplained' (23). The present study was designed to explore how a child's perceptions of exertion associated with an aerobic physical activity ultimately contributed to their activity participation. How perceived exertion was measured is considered next.

2.3.3 Measurement of the Rating of Perceived Exertion: RPE

Borg developed and validated the first category scale to measure perceived exertion (25-27, 119-120, 143-144). This 15 category scale is commonly termed the Borg or RPE (Rating of Perceived Exertion) scale. Measures derived from the scale were intended to increase scientific understanding of the subjective experience of exercise participation. The working premise underpinning the scale is known as Borg's Range Model (144). The model holds that as the range of exercise intensity increases from low to high a parallel perceived exertion range exists that is set equal for all clinically normal individuals (Figure 4) (144).

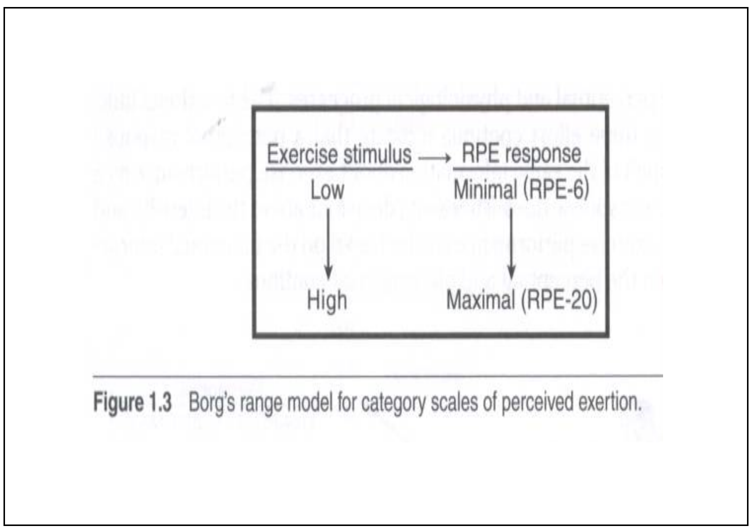


Figure 4: Borg's Range Model

From R. J. Robertson (2004) Perceived Exertion for Practitioners: Rating Effort with the OMNI Picture System. Champagne, IL: Human Kinetics, p. 7 (144).

Validity of Borg's 15-category scale and subsequently developed CR10 scale using the criterion measures of heart rate and oxygen consumption have been established across multiple modes of activity in both child and adult populations (26, 119, 144, 159-160). Borg's scales are the forerunners of the development of the OMNI Picture System of Perceived Exertion (144). The OMNI system employs verbal descriptors, numerical categories, and pictorial descriptors.

The pictorial descriptors depict an exercising individual providing visual cues that facilitate a mode specific perceptual response to various types of exercise (Appendix A) (144). This is particularly helpful for children to describe the perception of the exertion associated with their exercise experience. This makes the OMNI system an easy-to-use and readily understood method for obtaining a child's perceived exertion response. The OMNI Scale of Perceived Exertion (Child walking/running format) was employed in the current study (Appendix A).

Measurement of RPE can employ undifferentiated and differentiated perceptual responses (119, 143-144, 173). The undifferentiated RPE is a measure of the child's perception of overall body exertion (RPE-O) whereas a differentiated RPE measures perceived exertion in anatomically regionalized areas, i.e. the legs (RPE-L) and chest (RPE-C) (119, 143-144). The *undifferentiated RPE-O* reflecting a whole body response was obtained in the current study.

As with the Borg scales the reliability and validity of the OMNI scales have been established through controlled laboratory experiments (119, 143-144, 146-148, 173). Concurrent validity coefficients for the interrelations between OMNI Scale RPE and both oxygen consumption (VO2) and heart rate (HR) during walk-run exercise range from r = 0.85 to r = 0.94 for both female and male children (148). Noble cautions that reliability and validity "are dependent upon the degree to which researchers and practitioners comply with recommended administrative standards" (120). Accordingly, in the present investigation, standardized instructions and procedures for administration of the OMNI scale were followed according to the guidelines set by Robertson (Appendix A.1) (144).

2.3.4 Measurement of RPE: Match-Mismatch Paradigm

In the present investigation, a match-mismatch paradigm was used to compare predicted and actual ratings of perceived exertion. This paradigm made it possible to examine the intensity of perceived exertion as a potential barrier to a child's aerobic physical activity participation. In this cognitive appraisal paradigm, predictions about the exertional experience were compared with an actual exertional experience. The resulting response match provided an understanding about pre-participation prediction accuracy and its relation to the actual exercise experience. The relation between predicted and actual perceived exertion is helpful in assisting youth to correctly anticipate their exercise exertion. Such information is valuable to pre-determine the level of desired exercise intensity in both monitored and self-determined settings in order to accomplish physical activity goals (28, 120, 144).

This assertion is supported by Buckworth and Dishman who stated that 'participants' expectations influence their responses' and 'unconscious motivations create reality distortions' which impact physical activity participation (30). In fact, Poulton et al.'s longitudinal study found that patterns of overprediction of exercise discomfort were related to lower levels of physical activity in young adults (132). Poulton et al.'s reasoning for a 'prediction match-mismatch paradigm' is that physical inactivity may be associated with specific cognitions that lead to exercise avoidance. In Poulton et al.'s study, young adults avoided exercise based upon cognitions that formed perceptual predictions of undesirable discomfort. Accurate predictions of exercise discomfort are needed to develop interventional strategies that promote participation in a chosen physical activity and deter a pattern of exercise avoidance.

Thus, a logical next step in expanding the knowledge base was to investigate how a youth's predictions of perceived exertion (RPE) compared to actual perception of exertion during participation in aerobic exercise. In the current study, predicted and actual exertional ratings were obtained prior to and following an acute bout of an increasing aerobic exercise intensity, i.e. the PACER shuttle run. This study investigated how a predicted exertional rating matched or mismatched with the actual rating of perceived exertion in middle school children performing the shuttle run. Findings offered valuable information for novel educational methods that deter avoidance and increase physical activity participation.

2.3.5 Exercise-Induced Muscle Hurt

Pain has been described as 'an integral part of exercise' (122). It is defined as an 'unpleasant sensation associated with actual or potential tissue damage (144) that may be an influential perceptual barrier to exercise in youth. The naturally occurring skeletal-muscle pain or hurt that occurs during exercise is associated with increasing exercise intensity (27, 37, 40, 71-72, 122-123, 131, 144). The word 'hurt' was used throughout this investigation to describe the naturally occurring skeletal muscle 'pain' in children as suggested by the clinical research of Wong and Baker (181, 183). They found that children as young as 3 years old identified with the word hurt (e.g. where do you hurt) to best describe the experienced sensation of pain. Biddle and Mutrie recommended avoiding descriptions that cast exercise as negative or a punishment (23). In this regard it is possible that viewing an exercise as painful may contribute to a parallel association with the negative pain associated with clinical illness versus the positive muscle hurt associated with exercise benefit (23, 183).

It is important to distinguish that exercise-induced hurt and perceived exertion are distinctly separate sensory domains (122, 144). Ratings of perceived exertion have been shown to be separate from exercise ratings of skeletal muscle pain intensity indicating two generally concurrent, but independent constructs contributing to the more global construct of exercise discomfort (27, 37, 73, 78, 122-123, 144).

The neurobiological basis for the perception of skeletal muscular pain experienced with moderate to high intensity exercise has been described by Mense and others (60, 68, 109-110): "A muscle often exhibits local tenderness, i.e., local pressure stimulation of innocuous intensity elicits unpleasant pressure sensation or even muscle pain. This phenomenon is most likely caused by a sensitization of muscle nociceptors and other mechanosensitive receptive endings. The sensitization is probably due to the release of endogenous substances from the damaged tissue which lowers the mechanical threshold of nociceptive endings into the innocuous range. The result is that 'weak stimuli are able to excite nociceptors and elicit muscle pain" (109). The neurophysiological signal from the working muscle travels to the sensory motor cortex of the brain to be consciously interpreted by the individual as muscular pain, or in the case of children, muscular hurt (122).

O'Connor and Cook diagrammatically illustrated the transmission of this nociceptive muscle fiber signal to the brain for subsequent perceptual interpretation (Figure 5) (39, 122):

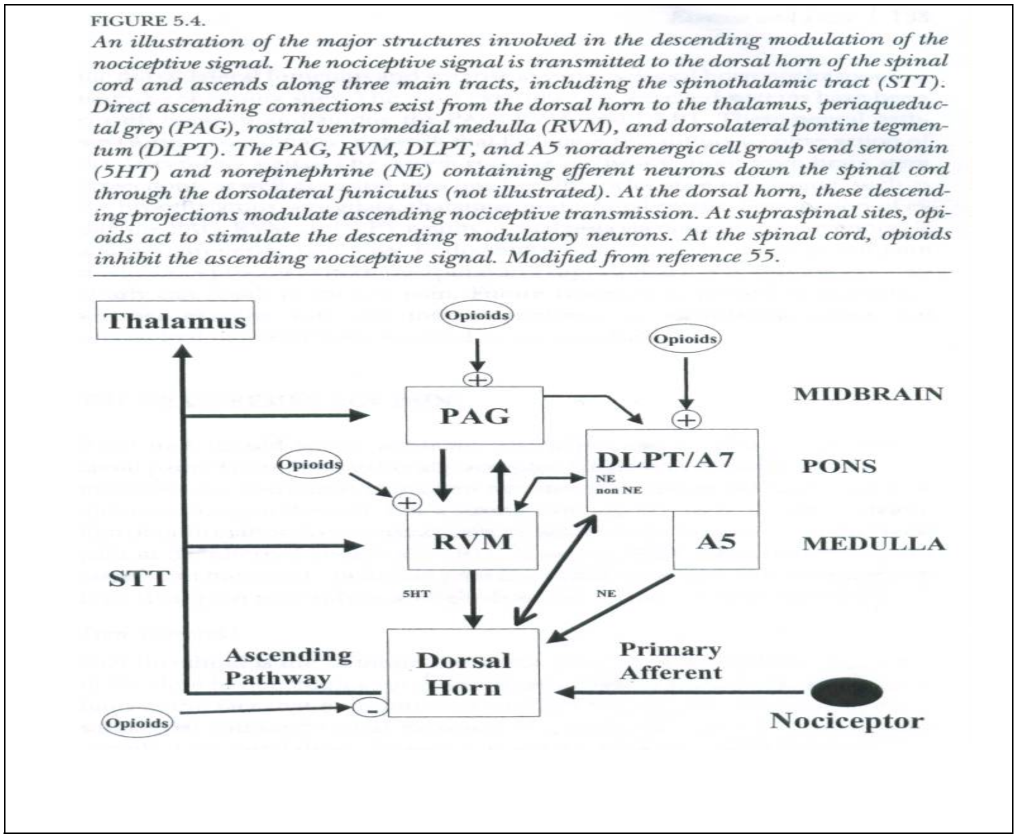


Figure 5: Nociceptive Signal

From O'Connor, P.J. & Cook, D.B. (1999) Exercise and pain: the neurobiology, measurement, and laboratory study of pain in relation to exercise in humans. Exercise & Sports Sciences Reviews, 27, p. 131 (122).

While acknowledging that the process remains only partially understood, Cook and O'Connor state that the neurobiological nature of the nociceptive signal provides 'a plausible framework by which exercise-induced alterations in the CNS could contribute to pain modulation' (122). Although the results of Signal Detection Theory research have been open to debate (122), this theory holds that the electrical stimulation of skeletal muscle produces a range of qualitative and quantitative intramuscular sensations relative to stimulus intensity (118). The experimentally conducted solicitation of pain sensation via electrodes appears to corroborate the proposed neurobiological process eliciting skeletal muscle pain perception with exercise.

Initial studies correlated naturally occurring forearm muscle pain with increasing handgrip exercise intensity (31, 55). These findings supported a link between neurobiological transmission and perceptual responses during exercise. Further, tolerance for the pain accompanying increasing exercise intensity was associated with increasing exercise endurance time (31). Subsequent investigation of exercise pain involved primarily cycle ergometry. Eight studies with adults documented that naturally occurring quadriceps muscle pain was uniformly reported during moderate to high intensity cycle ergometry (27, 37-38, 96, 121, 123, 176). Findings indicated that muscle pain may be useful in monitoring exercise intensity and interpreting exercise behavior (37, 122).

Several studies of exercise-induced analgesia (EIA) of naturally occurring muscle pain perception used chemical and control group manipulations (88). The design of these studies followed a sequence of pre-test measurement of pain, exercise, and post-test pain measurement of pain. As an example, Haier et al. reported decreases in pain sensitivity following a 1-mile run at self-selected intensity in both placebo and pain medicated adult groups (71). Haier et al. noted that the findings ‘suggest a basis for reports of mood changes with jogging and are consistent with a report of increased β-endorphin levels after marathon running’ (71). Janal et al. also noted decreases in pain perception following a high intensity (85% VO_{2max}) 6.3 mile run (81). Endogenous opioid neural systems are the implicated mechanism for such run-induced alterations, e.g. decreases in mood and pain perception resulting from exercise participation (79-81). Although acknowledging limited availability of studies, both Koltyn and Janal et al. summarized that pain tolerance increases following acute bouts of aerobic exercise (79-80, 87-88). Further, Janal et al. noted that ‘regular exercisers show greater pain tolerance than others even without recent exercise’ (80).

O'Connor and Cook concluded that the influence of 'pain on performance is sufficiently compelling' to advocate further research to fully understand its role (122). Further, they noted that there is a paucity of informative, systematic research even with the decades of interest in the occurrence of exercise pain. This was seen as perplexing given direct quotes from great athletes who emphasized that toleration of pain is a factor in facilitating endurance performance (122).

Existing research regarding naturally occurring exercise pain has primarily involved adults. However, the importance to also examine its impact on youth physical activity participation becomes clear within the clinical pain literature. Philips noted that "an individual in pain will tend to avoid stimulation and involvements and to reduce physical activities" (131). Further, over time physical activity avoidance was influenced by 'beliefs and memories' of pain determined by the 'overall preference for reduced discomfort' (131).

In a survey of research conducted on children's memory of pain, it was summarized that 'children's memories of painful experiences can have long-term consequences for their reaction to later painful events' (174). The authors suggested that 'clinicians consider: what children will remember when they treat them; assessing memories for earlier experiences; and, preparing children for the proposed experience with accurate and credible information at their level of understanding' (174).

Children's ability to *accurately* recall painful experiences has been reported (183). Their general memory for painful experiences revealed that both 'average and worst pain intensity recall showed little decrement over time' (185). In fact, in a study examining the impact of perceived pain on the daily lives and activities of children and adolescents, 622 of 722 participants (83%) reported pain experiences in the previous 3 months (149). The most frequent self-perceived triggers for pain noted by children were weather conditions (33%), illness (30.7%) and physical exertion (21.9%). In this context, physical exertion referred to sports and physical activities which were triggers of a pain episode during the daily activities of children (149).

Previous studies identified not only the existence of naturally occurring skeletal-muscle exercise pain but also recommended that its potential influence in determining exercise tolerance should be the subject of further inquiry. Robertson noted that measurement of the pain sensation may 'obtain a more comprehensive assessment of exercise strain' (144). Following the logic of previous investigators, muscle hurt was explored in the current study in combination with perceived exertion to gain further understanding of their combined role in the subjective perception of exercise *discomfort*. Exercise discomfort was reported by Poulton et al. to be influential in determining physical activity participation (132). However, the assessment of discomfort in this investigation consisted of a 1-10 scaled response to two questions: "How much discomfort do you anticipate experiencing during the bike test?" and "How much discomfort did you actually experience during the bike test?" Discomfort was not further defined. As such, the existing perceived exertion and muscle hurt research offered a logical next step to defining a more global perception of exercise discomfort. In this context, discomfort defined as the product of exertion and muscle hurt identified a potentially influential dual psychological barrier to exercise. The perceived muscle hurt and perceived exertion that accompanied participation in aerobic exercise of increasing intensity, (i.e. shuttle run), were examined for female and male children. Knowledge of the role of exercise discomfort as a perceptual barrier can subsequently be used to enhance the adoption and maintenance of physical activity participation.

How perceived pain, defined as leg muscle hurt, was measured is the next consideration in this review.

2.3.6 Measurement of the Rating of Perceived Muscle Hurt: RMH

The measurement of exercise-induced skeletal muscle pain (hurt) for this study included both intensity and anatomical location (26, 37, 122, 144). The recently developed Children's OMNI Scale of Muscle Hurt was employed to assess a child's perceptual rating of hurt (RMH) that was experienced during the aerobic PACER shuttle run (Appendix B) (145). The validity of the OMNI Scale of Muscle Hurt has been previously established (145).

Forerunners of the OMNI Hurt Scale are the Borg CR-10 and the Cook Pain Intensity Scale (26, 37). Both of these are category-ratio scales commonly used to measure exercise-induced pain in adults. In addition, the 'Wong-Baker Faces Pain Rating Scale' for pain assessment of children has been used extensively in the clinical setting (10, 24, 82, 181-183). The Borg CR-10 and Cook Pain Intensity Scale have been described as easy-to-use and score, reliable and valid (Pearson r = 0.78 to 0.91) (26, 122, 144). These scales include numerical (1-10) and verbal descriptors for respondent rating selection. The 'Wong-Baker Faces Pain Rating Scale' combines the numerical and verbal scoring system with pictorial cues depicting a range of facial expressions matched to increasing sensations of pain (181-183). These scales have demonstrated acceptable levels of validity and reliability (Pearson r = 0 .79) (10, 24, 82, 182).

In addition to verbal descriptors and numerical categories, the OMNI Scale of Muscle Hurt includes four facial expressions that depict varying degrees of pain responsiveness. These pictorial descriptors provide children visual cues that facilitate ratings of muscle hurt experienced during various modes of exercise (Appendix B) (145). It is particularly helpful for children to have a combination of verbal and pictorial descriptors to more easily establish their perception of muscle hurt associated with the exercise experience. This renders the OMNI Scale of Muscle Hurt an easy-to-use and readily understood method for assessing a child's naturally occurring skeletal muscle exercise pain (hurt).

O'Connor and Cook cautioned researchers and practitioners to 'use appropriate administration procedures and instructional sets' in pain assessment to assure interpretable data (122). Standardized instructions and procedures for administration of the Children's OMNI Scale of Muscle Hurt were followed according to the guidelines set by Robertson (Appendix B.1) (145). The measurement of a child's rating of perceived hurt (RMH) can be differentiated to a specific body region, i.e. legs. Based on previous cycle ergometer studies indicating that quadriceps muscle pain may be helpful in interpreting exercise behavior, the proposed study examined a child's perceptions of leg muscle hurt. Specifically, leg muscle hurt associated with aerobic shuttle run performance was explored.

2.3.7 Measurement of RMH: Match-Mismatch Paradigm

Employing the match-mismatch paradigm, both predicted and actual ratings of perceived hurt were used to assess this sensory construct as a potential barrier in a child's cognitive appraisal of aerobic physical activity participation. Recent advances using a combined psychophysical and MRI technique confirmed that 'a mental representation of an impending sensory event can significantly shape neural processes that underlie the formulation of the actual sensory experience' (89).

Two clinical studies also found that patients overpredicted their expected naturally occurring pain associated with simple physiotherapy exercises (135-136). They also noted that those who overpredicted subsequently corrected their prediction following the exercise events; those who correctly predicted did not change; and those who underpredicted subsequently tended to increase their predictions following exercise events. Similarly, other clinical studies with children and adults found a match-mismatch association between anticipated pain and actual pain linked to a variety of task performances (9, 40, 61, 65, 91, 108). For example, Council et al. noted that in adult patients, higher pain predictions correlated significantly with lower performance of specific limb movements (40). McCracken et al. also reported that predictions of pain during limb movement were related to previous predictions and experiences in chronic low back pain patients (108). Those with higher pain expectancy tended to overpredict new pain events.

Children's self-report of pain experiences accompanying venipuncture were examined using a visual analogue pain scale (61, 91). Male children were more likely to underestimate pain and female children were more likely to overestimate pain. Measuring pain recall two months later in these children, it was noted that 'children's recall of pain was quite good'. Analysis further revealed that patterns of response 'may provide clues about avoidance and coping behavior for children's pain'.

Dannecker et al. studied recalled, expected and actual naturally occurring upper arm muscle pain intensity and unpleasantness in ninety-five university students across three exercise sessions (43). They confirmed their hypotheses that 'recalled pain from the most recent episode of muscle pain would be significantly associated with expected pain and the accuracy of expectation increased across time as the onset of muscle pain occurred'. However, the authors cautioned that their analytic strategy did not take into account 'other psychological factors', (e.g. attributions, verbal persuasion), that can influence pain responsiveness. Gauvin and Spence addressed ‘other psychological factors’ which may influence ‘trait or state-like responses assessing habitual level of responding’ (64). These authors indicated that feeling states and emotions, e.g. predicted feelings of exertion and hurt, are ‘sensitive to a host of intrapersonal, interpersonal and environmental stimuli’. Further, they state that ‘transient psychological states vary both between persons and within persons across time’. They recommend that ‘the experimental setting be contrived to minimize bias and maximize consistency for subjects’. ‘Exercise specific measures more sensitive to the stimulus properties of exercise than measures which attempt to gauge broader dimensions of human movement’ are advised as ‘their content validity vis-à-vis exercise is of primary concern’ (64).

Thus, previous research confirmed that a match-mismatch paradigm may contribute to a better understanding of children’s rating of muscle hurt (RMH) related to participation in aerobic physical activity. Improved insight regarding pain perception as a barrier in the present study offered valuable information for novel educational methods to promote physical activity participation among children. Following the recommendations of Gauvin and Spence, the present investigation ‘minimized bias and maximized consistency’ to further knowledge regarding children’s perceptions by using valid and reliable exercise-specific measurements with standardized instructions and procedures (64).

2.3.8 Perception of Exercise Discomfort Summary: Exertion and Hurt

The reviewed literature suggested that perceived exertion and muscle hurt may each pose unique perceptual barriers to the adoption and maintenance of physical activity in both children and adults. Comparatively more research has examined the influence of perceived exertion (RPE) as a distinct perceptual barrier than with exercise-induced muscle hurt (123).

Although naturally occurring exercise pain (hurt) has not been 'documented well scientifically' (122), perception of exercise muscle hurt (RMH) has been identified (37-38, 122-123, 145). Future research was recommended for all age groups to further understand the influence that exertional perception and exercise hurt have on subsequent activity participation (78, 122-123, 145).

Thus, previous research provided scientific understanding of how expectations about exertional and pain intensity potentially influenced actual exercise perceptual responses during physical activity participation. Therefore, a logical next step was to explore these psychological constructs in combination. The proposed study combined perceived exertion and muscle hurt to form an index of exercise-induced physical discomfort. Employing the match-mismatch paradigm provided an established model (91, 132, 135-136) to investigate the combination of predicted and actual exercise discomfort in children participating in an acute aerobic exercise.

2.4 EXERCISE SELF-EFFICACY

2.4.1 Introduction

The most consistently reported cognitive variable to influence the 'choice of activity, amount of effort expended, and the degree of persistence' in a summary by Buckworth and Dishman was exercise self-efficacy (30). In this report, self-efficacy was defined as the 'belief in one's ability to engage successfully in a physical activity' (30). Sallis et al. summarized a review of psychological factors across multiple youth studies stating that exercise 'self-efficacy is… specific beliefs about one's personal physical activity that have been strongly associated with, or predictive of, physical activity participation' (155-156). It is logical to postulate from such reports that socio-cognitive variables such as self-efficacy may play a major role in forming the perceptual signals of discomfort that come into play during activity participation (6, 8, 13, 36, 70).

In fact, Robertson noted that the multiple influences of psychosocial mediators required 'much more research' in defining the constructs that influence exertional perceptions (Figure 2.2, p. 15) (144). Biddle and Mutrie reported that '30 per cent of the variance in perceived exertion cannot be explained by physiological parameters' (23). That perceived exertion is 'best viewed as a social psychophysiological phenomenon' has been argued by Rejeski and Hardy (74, 138-139).

Similarly, Tursky et al. used a multidimensional model to provide a more comprehensive understanding of pain perception (169). Their concept of pain was viewed as a neurobiological signaling process. This process was described as a 'complex psychophysiological phenomenon' that included social, cultural and personality factors. These factors contribute to the emotional responses to pain creating a 'pain perception profile' (169). Gerik concurred with such a comprehensive approach in her examination of pain management in children who 'vary widely in their perception and tolerance' to what is described as 'a very personal experience' (65). It was plausible that the 'very personal experience' of hurt or pain may interact with 'specific beliefs about one's personal activity', (i.e. exercise self-efficacy), to form a perceptual relation that influences a child's physical activity participation.

Synthesizing previous reports suggested that a potential contributor to the perception of exercise discomfort may be a child's exercise self-efficacy beliefs. This would partially account for Biddle and Mutrie's finding of a "30 per cent variance" in psychological factors that may mediate the intensity of the perceived exertion signal (23). In fact, Rejeski proposed that 'active parallel processing involving physiological, cognitive, and affective input' collectively influence exercise perceptions and subsequent participation (138). Numerous reviews of potential determinants of the physical activity perceptions of youth support this view (9, 41, 52, 83, 94, 101, 140-141, 164). As such it was important to extend research regarding the relations between these psychological constructs that could potentially contribute to a child's perceptions during aerobic activity participation.

The origins of self-efficacy for exercise reside in social cognitive theory which has been used in evidence based physical activity research with children (8, 11, 53, 153-156). The literature on exercise self-efficacy, a socio-cognitive variable, was next explored as a potential barrier to children's physical activity participation (8, 67, 70, 129-130, 152).

2.4.2 Social Cognitive Theory

Social cognitive theory (SCT) evolved through the work of Bandura who formulated a conceptual framework of interactive determinants (e.g. cognitions/affect of the person, behavior, and environment) that influence behavioral choices (11-13, 23, 30). The person-environment-behavior interaction provided a way to control life events having 'innumerable personal and social benefits' (11). Buckworth and Dishman visually conceptualized this triadic relationship (Figure 6) (30):

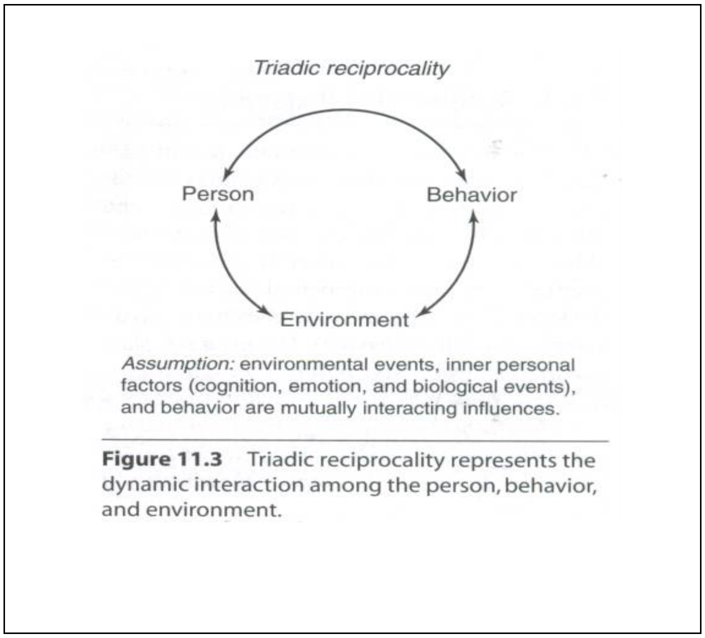


Figure 11.3 Triadic reciprocality represents the dynamic interaction among the person, behavior, and environment.

Figure 6: Triadic Reciprocity

From Buckworth, J. & Dishman, R. K. (2002) Exercise Psychology. Champaign, IL: Human Kinetics, p. 217 (30).

This triadic interactive process explains the extent to which a person can influence important life outcomes (11, 30). The greater the value of the outcome to the individual the higher is the attainment incentive. The higher the attainment incentive the greater the preparation an individual undertakes to achieve the chosen or intended outcome. The aim is to forecast as best as possible the outcome of behavioral choices made in the course of daily events. This process directs an individual to select behaviors to maximize control of valued life outcomes, providing a powerful motivator. People want to have influence over what they intend or choose to do (11-13, 30, 106).

Youth has been described as a time when issues of behavioral choice surface as prominent concerns (23, 36, 66-67, 127). The SCT model for behavioral choice acknowledges this need which partially explains its widespread use in research with young people. The desire of youth to have control of their choices is influenced by outcome expectations identified as different categories within SCT. These categories are subsequently linked with an individual's action or performance to yield differing psychosocial and emotional affect as portrayed in Bandura's explanatory diagram (Figure 7) (11):

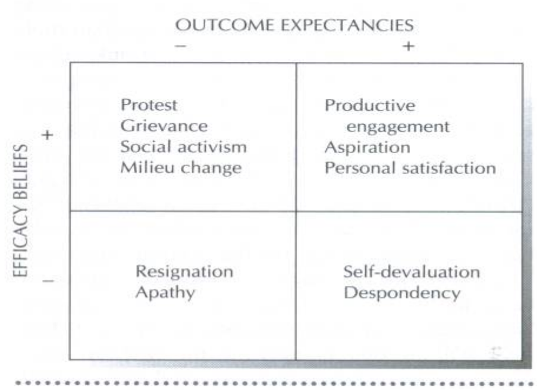


FIGURE 1.2. The effects of different patterns of efficacy beliefs and performance outcome expectancies on behavior and affective states. The pluses and minuses represent positive and negative qualities of efficacy beliefs and outcome expectancies.

Figure 7: Outcome Expectancies

From Bandura, A. (1986) Social Foundations of Thought and Action: A Social Cognitive Theory. Englewood Cliff, New Jersey: Prentice Hall, p.20 (11).

At the core of outcome expectancy and its concomitant affect is self-efficacy. Self-efficacy is the belief in one's ability to enact behavior and produce desired results, versus the belief that one cannot attain a desired outcome regardless of the amount of effort put forth (11-13, 156). Self-efficacy operates to support how a person can work toward and self-regulate desired goals and forms the cornerstone of Bandura's social cognitive framework. This is independently known as self-efficacy theory (11-13, 23, 30, 36).

2.4.3 Self-Efficacy Theory

Bandura explained the effect of self-efficacy with the following example**:** ‘a child is unable to perform at arithmetic and expects poor grades from that performance; subsequently the child becomes demoralized with the knowledge of inability to perform leading to self-devaluation’ (11). Research has found a similar expectation-response paradigm with physical activity. Exercise self-efficacy creates ‘specific beliefs about one’s personal physical activity that have been strongly associated with, or predictive of, physical activity participation’ (103, 106, 156). Efficacy becomes a central determinant of physical activity choice laden with accompanying emotional perception and consequences for future activity choices (11-13, 103-104, 150, 158).

Exercise self-efficacy underlies expectations for capability of performing physical activities and exerts a major influence on thoughts which can either help or hinder capabilities to drive performance (70, 104, 106, 126, 141, 150, 152). The process becomes cyclic as behavior in turn creates outcome expectations and future appraisals that lead to evolving behaviors and self-efficacy beliefs (Figure 8).

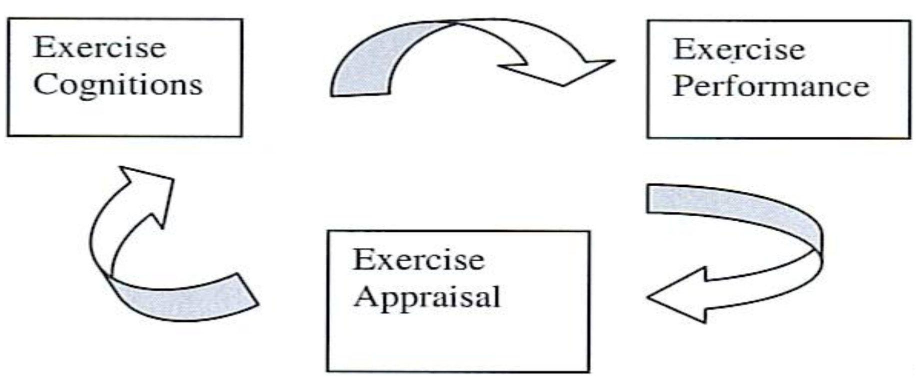


Figure 8: Exercise Cycle

Exercise self-efficacy is a process of learning, acquired in various ways which serves to promote the ongoing cycle of physical activity. Previous performance experience, observations of or feedback from others, and appraisal of physiological states related to physical activity contribute to how exercise self-efficacy can originate within an individual (13, 23, 104, 106-107 126, 150). Each concept is briefly discussed below.

1. Previous performance experience: contribution to exercise self-efficacy

The judgment of previous performance as successful or unsuccessful provides a major source for efficacy and influences future performance expectation. Previous physical activity success improves exercise self-efficacy appraisal and failure lowers it (13, 21, 53, 155). This has been found to occur in numerous studies with youth where perceived ability regarding physical activity based upon historical performance has been found to influence both actual performance and future performance attempts (51, 70, 83, 103, 126, 130, 141, 152).

Biddle and Mutrie recommended that studies be undertaken to examine connections between exercise self-efficacy concepts and self-monitoring of physical exertion during physical activity (20, 23). McAuley and Blissmer conducted two such studies that examined self-efficacy related to the perceptions of exertion (RPE), in adult male samples (103). They noted high efficacy was related to lower perceived exertion experienced during low impact aerobic exercise programs (103, 106). Pender et al. similarly found that the higher the self-efficacy the lower the perceived exertion in adolescent girls engaged in cycle ergometry (126). Robbins et al. examined self-efficacy, exertional perception (RPE), and physical activity participation and found 'lower perceptions of exertion may improve self-efficacy' among adolescents performing treadmill exercise (141). They also noted gender differences in the relation between efficacy and exertion. Specifically, boys with high pre-activity self-efficacy reported lower RPE during exercise, while pre-activity self-efficacy for girls did not yield a significant relationship with RPE. Interestingly, post-activity self-efficacy significantly correlated with RPE for both genders. The authors recommended additional research to provide evidence that 'exercise alone was responsible for the higher post-activity self-efficacy found with both males and females' (141).

2. Observations of or feedback from others: contribution to exercise self-efficacy

A second contributor to the development of exercise self-efficacy is described by Bandura as, 'social comparative information which figures prominently in self-efficacy appraisals' (11). For example, competitive school games afford a child the ability to compare performance of others with self–performance which leads to an exercise efficacy self-appraisal. Petosa investigated the relation between multiple social-cognitive theory variables and physical activity in both college students and adolescents (129-130). It was found that social outcome expectations predicted physical activity level. However, research in this area is limited. Although social comparative influences are likely to evoke efficacy self-appraisal, a firm conclusion regarding this effect requires further research (129-130).

Feedback from others, what Biddle and Mutrie label verbal/social persuasion, also provides social comparative information (23). However, verbal/social persuasion may only weakly influence exercise self-efficacy as compared to the more influential previous performance experience or the moderately important social self-comparison (23). For youth this factor may still be important in certain situations such as team participation in physical education classes or sports related activities. Such situations may potentially contribute substantially to evolving exercise self-efficacy appraisal. Again, systematic 'research on physical activity and self-efficacy with children' is required to confirm the actual effect of efficacy on exercise beliefs (30, 50, 104, 141).

3. Pre-participation arousal: contribution to exercise self-efficacy

The final factor that can enhance self-efficacy and improve performance is defined by Bandura as elimination of a 'physiological state of emotional arousal', e.g. pre-exercise anxiety-induced heart rate elevation (11). Bandura noted that when emotional arousal with a perceived threat could be tempered with techniques learned through such processes as biofeedback, heightened self-efficacy also occurred and resulted in a simultaneous improvement in exercise (23, 30). However, evidence for this effect during exercise is limited. Biddle and Mutrie recommended studies to examine connections between self-efficacy concepts, perception of exertion, and self-monitoring of physical exertion during physical activity (23).

Motl et al. manipulated self-efficacy beliefs in college women by giving subjects false information about their performance in a preliminary incremental cycle exercise test (115). Although the primary aim of this study was to examine perception of leg muscle pain related to efficacy beliefs, ratings of exertional perception for the overall body were also obtained. A moderate inverse relation was found between exercise self-efficacy and perceived pain and exertion during the first five stages of the preliminary incremental test. However, no significant relation was found for efficacy, pain and exertional ratings between the preliminary cycle exercise test when false information was provided and the moderate intensity cycle exercise test. These differential findings led the authors to recommend 'further examination of the possible effects of self-efficacy on naturally occurring quadriceps muscle pain during exercise' (115). Taking this recommendation a step further, the proposed investigation examined the relation between exercise discomfort (hurt *and* exertion) and exercise self-efficacy using a match-mismatch paradigm in children performing the PACER shuttle run.

2.4.4 Summary: Exercise Self-Efficacy

A youth's exercise self-efficacy ultimately leads to perceptions that influence physical activity behavior. Exercise self-efficacy has been described as 'the strongest and most consistent predictor of exercise behavior' with children (23, 156, 158). It has been considered the 'cognitive variable most consistently associated with physical activity' and is described as both a 'determinant and a consequence of physical activity' (30, 70) (Figure 9).

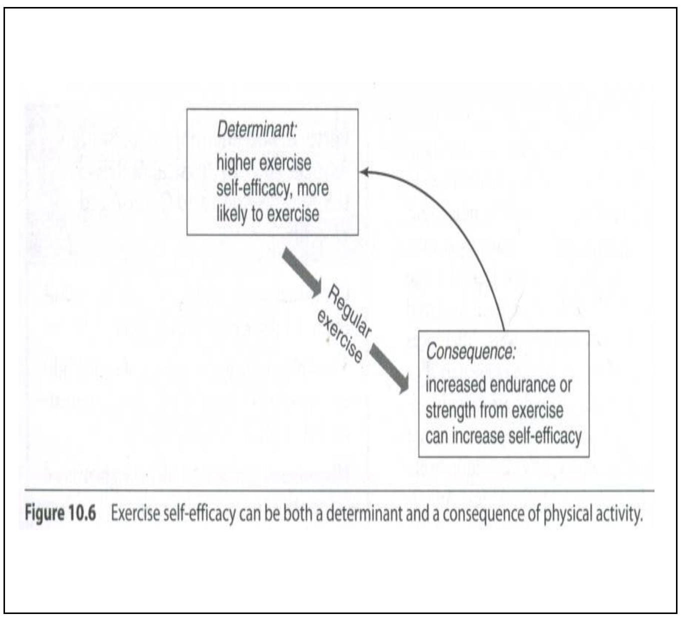


Figure 9: Exercise Self-Efficacy

From Buckworth, J. & Dishman, R. K. (2002).
Exercise Psychology. Champaign, IL: Human Kinetics, p. 201 (30).

However, Dishman proposed that physical activity interventions for youth have not been effective because 'social-cognitive correlates which are putative on volitional choice have not been targeted' (51-52). Further investigation was recommended to 'target' the influence of such socio-cognitive variables.

The present study examined children's exercise self-efficacy beliefs as a potential barrier influencing activity participation during an acute bout of aerobic exercise. This was deemed important since 'self-efficacy judgments are modifiable' using interventions based upon accurate efficacy information (158). Previous research, while limited, has focused on the relation between self-efficacy and perceived exertion (6, 8, 104, 126, 129, 141, 150). However, the relation between exercise self-efficacy and the newly developed psychological construct of exercise discomfort (i.e. exertion and hurt) had not been examined. Nevertheless, the potential for exercise discomfort and self-efficacy to be interrelated as perceived barriers impacting a youth's aerobic physical activity participation was an attractive hypothesis. Further scientific inquiry was recommended. Therefore, in the present investigation, exercise self-efficacy was examined prior to and following the PACER shuttle run to explore the relation of this construct in a match-mismatch paradigm with predicted and actual exercise discomfort.

2.4.5 Exercise Self-Efficacy Measurement

McAuley and Mihalko reviewed 85 published studies employing the exercise self-efficacy construct (105). In general, measures used in these studies proved to be theoretically founded and reliable. The authors included a complete listing of each instrument's reliability and the type of exercise study in which it was employed. The importance of their detailed work lies in what they call 'the nature of the self-efficacy construct which argues for the value of domain specific measurement'. McAuley and Mihalko encourage that future studies on self-efficacy 'employ it as a predictor of exercise behavior, and to assess self-efficacy at some prescribed frequency, duration and intensity' (105). They cautioned the need for 'appropriate and accurate conceptualization and measurement' of the construct. This directive has been further emphasized by Feltz and Chase who stated that "measurements with children should also follow the recommendation of Bandura (11-13) to use a microanalytic approach to matching the efficacy measure to the corresponding task" (59)

A scale has been developed and modified to specifically examine aerobic (dancing, swimming, biking, walking, cheerleading, and sports, e.g. soccer) exercise self-efficacy with children and adolescents (53, 117, 157). However, this global assessment of exercise self-efficacy does not follow the recommendations of 1) McAuley and Mihalko to 'employ efficacy as a predictor of specific exercise behavior' (105); and 2) Feltz and Chase to 'match the efficacy measure to the corresponding task' (59).

Two studies involving young and middle aged-adults respectively report assessment of perceived running self-efficacy (90, 151). First, LaGuardia and Labbè used a 14-item scale with two subscales to 'assess the relationship between self-efficacy beliefs and running performance' with 80 young adult competitive runners (90). Significant Pearson correlations were obtained between self-efficacy and both expected and actual performance time. Second, Rudolph and McAuley developed an exercise self-efficacy scale according to Bandura's recommendation for task-specific measurement of self-efficacy (11, 150-151). This running-specific scale was employed in two studies with undergraduate students (mean age: 21 years). The scale was "comprised of items representing the participant's confidence in being able to successfully complete successive 10-minute increments at a moderately fast pace" (150). Internal consistency for this scale was reported at $\alpha > 0 .95$ (150).

The present study examined exercise self-efficacy and its relation with exercise discomfort using Rudolph and McAuley's running-specific scale in a match-mismatch paradigm (Appendix C). The reasoning for selecting this scale in the present study was: 1) it is domain (running) specific; 2) the authors' used this scale in their second study to examine self-efficacy *in relation to perceived effort* during running; and, 3) the authors reported high reliability of their instrument; 'the acceptable range is 0.71 to 0.81 for internal consistency with measures of perceived behavioral control' (105, 150). Two modifications were made to the scale per previous research recommendations: 1) the time intervals were changed to 'correspond to the task' (59), i.e. the PACER; and, 2) the percentage rating format was modified to a Likert rating format deemed more suitable for children. These modifications were intended to facilitate application of the scale for use with children according to the recommendations of Saunders, Motl and Dishman et al. (51, 53, 117, 157). Procedures to administer the scale were detailed in the methods section of Chapter III.

2.5 PHYSICAL ACTIVITY ENJOYMENT

2.5.1 Introduction

Enjoyment is a cognitive variable that is reported to have a positive association with children's physical activity (54, 75-77, 104, 142). Heck cautioned that it is important to define exercise enjoyment (77). In this regard, the Physical Education/Health First Alliance of Florida definition of enjoyment as 'fun' from their surveys with children was used in this study (75).

Research suggests that enjoyment may play an important role in the adoption and maintenance of physical activity in children (54, 76, 133, 142). Enjoyment has been cited as the ‘only *consistent* predictor of physical activity’ participation (47). It is described as an ‘affective mediator’ requiring further scientific understanding (54). This section explored what was known about exercise enjoyment and how it related to exercise self-efficacy and perceived exercise discomfort. Understanding the potential interactive role of these psychological constructs as confounding barriers in shaping children’s exercise behavior was consistent with the Sallis et al. recommendation to ‘develop psychological models or theories specific to physical activity’ adoption and maintenance (156).

2.5.2 ‘Understudied Mediator’

In a national sample of 1,054 children in grades 4 through 12, enjoyment, afternoon time, and family support were identified as factors that ‘have a strong and consistent relationship with a child’s physical activity’ (153). In a descriptive study of 6078 children, the perception of 11-19 year olds that physical activity was fun clearly related to higher physical activity participation (44). A study on physical activity motivation involving 202 middle school boys and girls found that personal fulfillment, which included the factor of enjoyment, was the strongest motivator to be physically active (76).

Although these studies have shown physical activity enjoyment to be an important variable in the implementation and maintenance of activity participation, enjoyment of physical education consistently declined in a longitudinally tracked 3-year prospective study of 414 fourth grade children (133). Both boys and girls (particularly girls not involved in sports) demonstrated a decline in physical activity from the fourth grade to the sixth grade. This led the authors to suggest a need to match a student with an activity preference to encourage physical education enjoyment. Ultimately the authors concluded that investigation of what promotes physical activity enjoyment in children is necessary.

Understanding what promotes physical activity enjoyment has been demonstrated in two diverse studies. Klentrou et al. tested two hundred fifty-six adolescents using the 20-m shuttle run to predict physical fitness (86). Adolescents reporting enjoyment of physical activity had the highest levels of aerobic fitness as determined by predicted VO_2 peak (shuttle run estimation) and percent body fat. It is possible that the physically fit adolescent may have experienced less discomfort leading to greater enjoyment of the activity as has been suggested by Robbins et al. (141). In the second study, Biddle et al. investigated 'beliefs about athletic ability' in youth aged 11-19 years (22). They reported that physical activity enjoyment could be directly predicted from those children who held beliefs that physical activity ability, (i.e. exercise self-efficacy), was a learning opportunity that they could improve.

Previous studies indicated a relation between physical activity enjoyment and ability beliefs. These beliefs may affect physical activity participation as indicated by physical fitness parameters. If perceived exercise enjoyment and ability are tied to a higher level of participation and physical fitness, they may be plausibly connected to less exercise discomfort. In a study of adolescents aged 9-17 years, Robbins et al. pointed out that 'pleasurable experiences are critical to increasing physical activity self-efficacy and subsequent frequency of the activity' (141-142). Enjoyment in the present study was postulated to be tied to ability beliefs about physical activity (exercise self-efficacy) and to reflect a perceptual belief that was the reverse of a perception of exercise discomfort (141).

This was theorized because what appears to be occurring is the cyclic process of cognition (beliefs) and behavior (exercise), vested in principles of social cognitive theory (11-

13, 23, 30, 67, 101, 127). In turn, outcome expectations and future physical activity appraisals are created by youth. This can lead to evolving lifestyle physical activity behaviors based upon those appraisals (56, 101, 102, 177). In fact, in a study of adolescent girls, Dishman et al. found that an increase in physical activity enjoyment led to an increase in physical activity participation (54). This affective response also had an indirect effect on physical activity participation by influencing exercise ability beliefs, i.e. exercise self-efficacy (54). However, Dishman et al. emphasized that the paucity of research on enjoyment as an affective mediator with exercise self-efficacy in youth necessitated further study before firm conclusions could be established.

Thus, the proposed study built upon previous findings to examine enjoyment in relation to self-efficacy and to explore how these social cognitive variables were involved with perceptions of exercise discomfort in middle school children performing the PACER shuttle run.

2.5.3 Physical Activity Enjoyment Measurement

Gauvin and Spence noted that affect is the most fundamental expression of the value attached to a given feeling state (64). Further, measurement of exercise-induced changes in feeling states involves: 1) identification of the exercise stimulus (e.g. shuttle run) to which the feeling state (enjoyment) is attached; and 2) establishment of a baseline (predicted versus actual) for this exercise-specific affect. Finally, the validity and reliability of the 'state-like measure' must be suitable to the experimental design.

In the present study, the 16-item Physical Activity Enjoyment Scale (PACES) was used prior to and following the PACER according to a match-mismatch paradigm (Appendix D)

(54, 84, 116). The 16-item PACES is consistent with the above measurement recommendations (64). It has been shown to be a valid and reliable measurement of the single substantive factor of physical activity enjoyment in children (54, 84, 116). This scale is described as 'invariant across race and independent of physical fitness' with validity coefficients of $r = 0.50$ (cycle) to 0.90 (jogging), $p < 0.001$) (54, 84, 142). Norms are not cited. Psychometric data are reported from studies employing male and female undergraduate students and adolescent girls (mean age of 13.6 years) (84-85, 116). One modification was made to the scale per previous recommendation: the instructional sentence was changed from "When I *am active…*" to "When I *run*…" to 'correspond to the task' (59), i.e. the PACER. Associated administration procedures are detailed in the methods section, Chapter III.

2.6 AEROBIC EXERCISE: PACER

The 'task and situation specific' aerobic exercise used in this investigation was the PACER (Progressive Aerobic Cardiovascular Endurance Run). The PACER is a 20-meter Multi-Stage Shuttle Run that is frequently used as a field test for aerobic fitness in youth (18, 46, 97-98, 111, 178). The national youth fitness assessment program, ***FITNESS*GRAM®,** employs the easy-to-use PACER as a "default aerobic capacity test" with its progressive intensity described as "easy at the beginning and harder at the end" (97, 111). The PACER speed is increased each minute via an audio recording control that simulates progressive stages on a treadmill test (18). Children run back and forth over a defined 20-meter lane according to an increasing pace. The number of completed laps by a child is scored according to the criterion referenced standards (18). This is the basis for classifying aerobic fitness according to the ***FITNESS*****GRAM®** norms. The PACER is administered using a standardized musical format, and includes a "built in warm-up that helps children to pace themselves effectively" (111). It is described as a "fun alternative" to distance running (111). Its increasing intensity served as the exercise forcing function in the present study to elicit the physiological responses that influenced the perceptions of exertion and muscle hurt, i.e. the discomfort index.

The multi-stage PACER fitness test has been adapted from the original research of Leger, Lambert et al on the 20-meter shuttle run (18, 92-93, 95, 179). The PACER was validated by measuring maximal oxygen uptake (VO_2max) in boys and girls aged 8-19 years old. Using fastest speed plus age, a regression equation to estimate VO_2max was modeled as follows: 31.025 + 3.238 (speed) – 3.248 (age) + 0.1536 (speed x age). Age related criterion referenced standards with calculated VO_2max estimates were derived from this equation (18, 95, 98).

Liu et al. examined the reliability and validity of the 20-meter shuttle run for 62 males and females, aged 12 to 15 years (95). Test-retest reliability resulted in an intraclass coefficient of r = 0 .93. The number of laps correlated significantly with measured treadmill VO_2max in both males and females (r = 0.69). It was concluded that the shuttle run test is reliable and valid and that the derived regression equation to estimate VO_2max demonstrated an acceptable range of error.

Mahar et al. also established the validity of the PACER reporting a positive correlation between PACER laps and measured treadmill VO_2max (r = 0.55) in 12-14 year old girls (98). In an earlier study with 10-11 year old males and females, Mahar et al. administered two trials of the PACER to examine test-retest reliability. They reported that 'reliability referenced estimates were high for two trials (*r* = 0.89 for both males and females, and acceptable for one trial (*r* = 0.80) for males and 0.79 for females' (97).

Welk et al. tested a large sample of seventh and eighth graders to examine the validity of the PACER and Mile Run tests (178). PACER correlation with measured VO_2max was moderate (*r* = 0 .51). However, the authors reported that the test may overestimate measured VO_2max values in middle school youth.

Studies have tested the concurrent validity of the PACER with age groups between 11-17 years (15). These investigations established that the range of validity coefficients and standard errors of estimate are similar to those for the one-mile run. It was concluded that the PACER demonstrated moderate concurrent validity as a field test of aerobic fitness (15). Cureton and Plowman reported that the PACER is 'moderately good for estimating VO_2max and approximately equal in its validity for use in children 10years of age and above' (42). They emphasize its high content validity as an 'attractive feature'.

Based on research findings, the PACER was used as a reliable and valid field test of aerobic fitness. Baumgartner et al. reported that 'less fit participants will end the test first; while the more fit participants will continue for a longer period' (18). Higher levels of fitness have been associated with higher levels of exercise self-efficacy and physical activity enjoyment (18, 22, 86, 111). Buckworth and Dishman stated that 'physiological variables can play a critical role in behavior and interact significantly with psychosocial constructs' (30). Although Buckworth and Dishman did not define 'discomfort', they emphasized that "physical discomfort has been negatively correlated with self-report of physical activity and those who perceive their health as poor are unlikely to adopt and adhere to an exercise program" (30).

The present study employed the PACER as an exercise forcing function to examine predicted and actual exercise discomfort, pre-, and post-exercise self-efficacy and enjoyment as potential psychological barriers in male and female middle school children aged 11-14 years.

2.7 LITERATURE REVIEW SUMMARY

Evidence was limited, but suggestive regarding the perceived barriers of predicted and actual exercise discomfort (exertion and hurt), pre-, and post-exercise self-efficacy and enjoyment in relation to physical activity participation.

Both perceived exertion (RPE) and exercise-induced muscle hurt (RMH) have been implicated as psychological barriers to participation in aerobic exercise of increasing intensity. Exertion and muscle hurt were used in the present investigation to define the perception of exercise discomfort which has been indirectly alluded to in previous research. It was important to study exercise discomfort as Buckworth and Dishman assert that it is 'negatively correlated with self-report of physical activity' (30). 'Discomfort' resulted in avoidance of exercise in adults (132).The current study applied a match-mismatch paradigm as an initial step to examine exercise discomfort in middle school children (11-14 years of age) performing a specific aerobic exercise, the PACER.

Additionally, there was limited evidence concerning the effect of socio-cognitive variables on the development of discomfort perception. Psychological mediators are known to influence perceived exertion (144) and perceived hurt (122, 131). However, the relation between such potential mediators as self-efficacy and enjoyment to both perceived exertion (RPE) and muscle hurt (RMH) has not been extensively studied (23, 54, 141, 144). Self-efficacy, a central construct of Bandura's social cognitive theory, has been consistently identified as a powerful determinant of physical activity in children (127, 141, 156). Enjoyment has also been labeled a 'consistent predictor' of physical activity in children (54, 153). Yet, exploration of the possible inter-relations of these socio-cognitive variables with perceived exercise discomfort using a match-mismatch paradigm was not well-studied.

Knowledge obtained from the current investigation about a child's predicted and actual subjective perceptions of exercise discomfort, pre-, and post-exercise self-efficacy and enjoyment provided a valuable first step in developing creative strategies to promote physical activity participation and to reverse the reported physical activity decline with its loss of health benefits (7, 35, 86, 134, 162, 171, 172, 177).

Based upon previous research recommendations, the current investigation used the match-mismatch paradigm to study the relation between predicted and actual exercise discomfort (exertion/hurt), pre-, and post exercise self-efficacy and enjoyment in 11-14 year old male and female children performing an aerobic activity of increasing intensity, the PACER shuttle run (Figure 1).

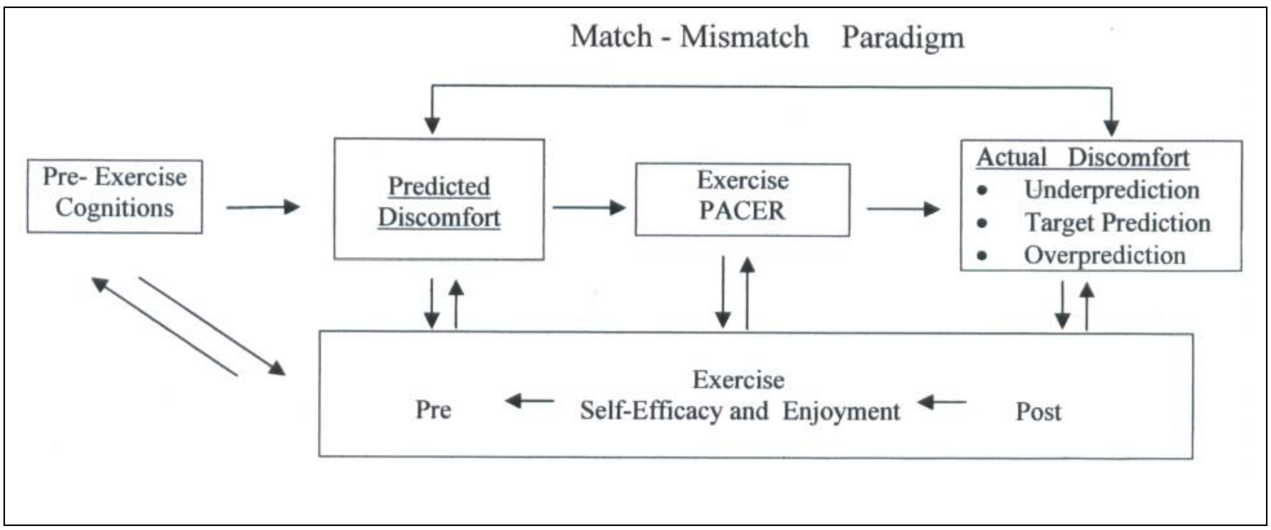


Figure 1: Match-Mismatch Paradigm: Exercise Discomfort, Self-Efficacy, Enjoyment

3.0 METHODOLOGY

3.1 SUBJECTS

3.1.1 Introduction

Thirty four healthy male and female middle school (grades 6, 7, 8) children, ages 11-14 years, participated as subjects in all phases of this investigation (Table 1).

Table 1: Gender, Grade, Age Data

Variable	n	%
Gender		
Female	18	52.9
Male	16	47.1
Grade		
Sixth	14	41.2
Seventh	11	32.3
Eighth	9	26.5
Age		
11	10	29.4
12	10	29.4
13	10	29.4
14	4	11.8

The choice of middle school students was based upon previous research (1, 35, 162). Since activity decreases and weight increases during adolescence, it is important to identify physical activity barriers that may operate at the onset of this developmental period (1, 35, 162).

All subjects were volunteers from the University of Pittsburgh affiliated Falk Laboratory School. Founded in 1931, Falk Laboratory School is an elementary/middle demonstration school (K-8) that emphasizes cultural, racial, socioeconomic, and gender diversity (170). School administrators, parent(s)/guardian(s) of the children and the children themselves were involved in all phases of the recruitment process. Inclusion criteria comprised healthy middle school children who: a) had medical clearance to participate; b) were willing to undertake the PACER 20-Meter multi-stage shuttle run test; and, c) agreed to provide demographic information, e.g. height, weight, BMI. Exclusion criteria consisted of children who had: a) clinical, neuromotor, or cognitive contraindications to undertake the PACER test; and, b) previous experience with OMNI category scales (RPE and/or RMH).

Written consent to participate in all research projects conducted at the Falk Laboratory School was obtained by school administration at the beginning of the academic year (Appendix E). The school administrator was notified regarding non-participation decisions. For the current project, a letter containing the research protocol with an attached consent form was sent to the parent(s)/guardian(s) (Appendix E.1). Nineteen female and sixteen male children and their parents submitted signed consents. However, one female subject was unable to participate in the PACER (exercise) and post-exercise assessment due to a knee injury unrelated to the study. A total of 34 subjects participated in all phases of this investigation. The rationale underlying this investigation, as well as its attendant risks and benefits were explained to the subject and their parent(s)/guardian(s) (Appendix E.1). Questions regarding the investigation were answered by the principal investigator during Physical Education classes. Participating subjects were assigned an identification number (Appendix F) to assure confidentiality.

All experimental procedures and related participation consent complied with the Human Use Guidelines of the American College of Sports Medicine (4) and were approved by the University of Pittsburgh's Institutional Review Board (170).

3.1.2 Descriptive Data: Age, Height, Weight, BMI

Descriptive information including age, height, weight, and BMI (Appendix F) for each subject were obtained from the school nurse (who routinely records this information) one week prior to the pre-exercise assessment (Protocol Day 1). Table 2 summarizes these data for the entire group and by gender.

Table 2: Age, Height, Weight, Body Mass Index (BMI) Data

Variable	Group	Median	Mean	SD	Minimum	Maximum
Age (Yrs)	**Total**	**12.00**	**12.50**	**0.91**	**11.00**	**14.00**
	Females	**12.50**	**12.50**	**0.99**	**11.50**	**14.00**
	Males	**12.50**	**12.50**	**0.83**	**11.00**	**13.75**
Height (cm)	**Total**	**154.31**	**154.51**	**7.75**	**140.34**	**170.18**
	Females	**156.21**	**154.31**	**7.07**	**142.25**	**165.10**
	Males	**152.09**	**154.74**	**8.72**	**140.34**	**170.18**
Weight (kg)	**Total**	**46.27**	**48.00**	**11.88**	**29.02**	**72.12**
	Females	**45.81**	**47.55**	**12.25**	**29.02**	**72.12**
	Males	**48.42**	**48.53**	**11.81**	**34.02**	**68.72**
BMI (kg/m^2)	**Total**	**19.00**	**19.94**	**3.64**	**13.40**	**28.70**
	Females	**18.70**	**19.82**	**3.92**	**13.40**	**28.70**
	Males	**19.65**	**20.09**	**3.93**	**16.00**	**26.10**

The mean BMI for females (19.8±3) and males (20.1±3) were within the normal age percentile range for children (34).

3.1.3 Descriptive Data: Physical Activity and Sport Participation

Physical activity and sport participation history were obtained by self-report questionnaire administered with investigator and teacher supervision (2, 3). Thirty one subjects completed the questionnaire during their Physical Education class and three subjects completed the questionnaire during a separate class (unable to attend their PE class) one day prior to the pre-exercise assessment (Protocol Day 1). PA data for the total group and by gender are summarized in Tables 3 and 4.

Table 3: Physical Activity and Sport Participation

	Females			Males			Total	
	n	%		n	%		n	%
Days of hard exercise								
None	1	5.6		1	6.3		2	5.9
1-2	3	16.7		0	0		3	8.8
3-5	4	22.2		4	25.0		8	23.5
6-8	6	33.3		2	12.5		8	23.5
9 or more	4	22.2		9	56.3		13	38.2
	18	100.0		16	100.0		34	100.0
Days of light exercise								
None	1	5.9		0	0		1	3.0
1-2	5	29.4		2	12.5		7	21.2
3-5	2	11.8		2	12.5		4	12.1
6-8	2	11.8		4	25.0		6	18.2
9 or more	7	41.2		8	50.0		15	45.5
	18	100.0		16	100.0		33	100.0
Missing	1			0			1	
Hours/Day TV, Video, Computer Games								
1 or less	7	42.1		4	25.0		11	34.3
2-3	8	42.1		9	56.3		17	48.6
4-5	3	15.8		1	6.3		4	11.4
6 or more	0			2	12.5		2	5.7
	18	100.0		16	100.0		34	100.0
Competitive Activities								
None	5	26.3		1	6.3		6	17.1
1	4	21.1		1	6.3		5	14.3
2	5	26.3		7	43.8		12	34.3
3	1	10.5		1	6.3		2	8.6
4 or more	3	15.8		6	37.5		9	25.7
	18	100.0		16	100.0		34	100.0

Over 85 % of the total group reported participating in at least 3 days per week of vigorous exercise, and over 75% of the total group reported at least 3 days of light exercise per week. Conversely, over 75% of the total group reported less than 2-3 hours per day in sedentary activity such as watching television or using a computer. This was slightly less than the reported national mean of 3 hours per day for sedentary pursuits (71). Subjects reported participating in 13 different *competitive* activities (Appendix J-1). For the total group, the 3 most popular competitive activities were basketball (reported by 19 subjects or 31.7%), soccer (reported by 13 subjects or 21.7%), and running (cross-country) (reported by 7 subjects or 11.7%).

Leisure physical activity and sport participation hours/week (Table 4) were calculated according to Aaron et al. (Appendix J-2) (2). A positively skewed distribution of leisure physical activity hours (median and mean) was observed as indicated in Table 4. Subjects in the present study reported participating in 37 different *leisure* activities at least 10 times during 2006 (Appendix J-3). For the total group, the 3 most popular activities were basketball (reported by 22 subjects or 64.7%), soccer (reported by 18 subjects or 52.9%), and running for exercise (reported by 14 subjects or 41.2%).

Table 4: Leisure Physical Activity (PA) and Sport Participation (Hours/Week)

	Leisure PA Hours/Week			
Group	**n**	**Median**	**Mean**	**SD**
Total	34	7.49	9.50	9.35
Females	18	4.37	5.63	4.13
Males	16	11.47	13.85	11.61

3.2 RESEARCH DESIGN

3.2.1 Design

This investigation employed a within group PRE-, POST-EXERCISE Test experimental design (Figure 10):

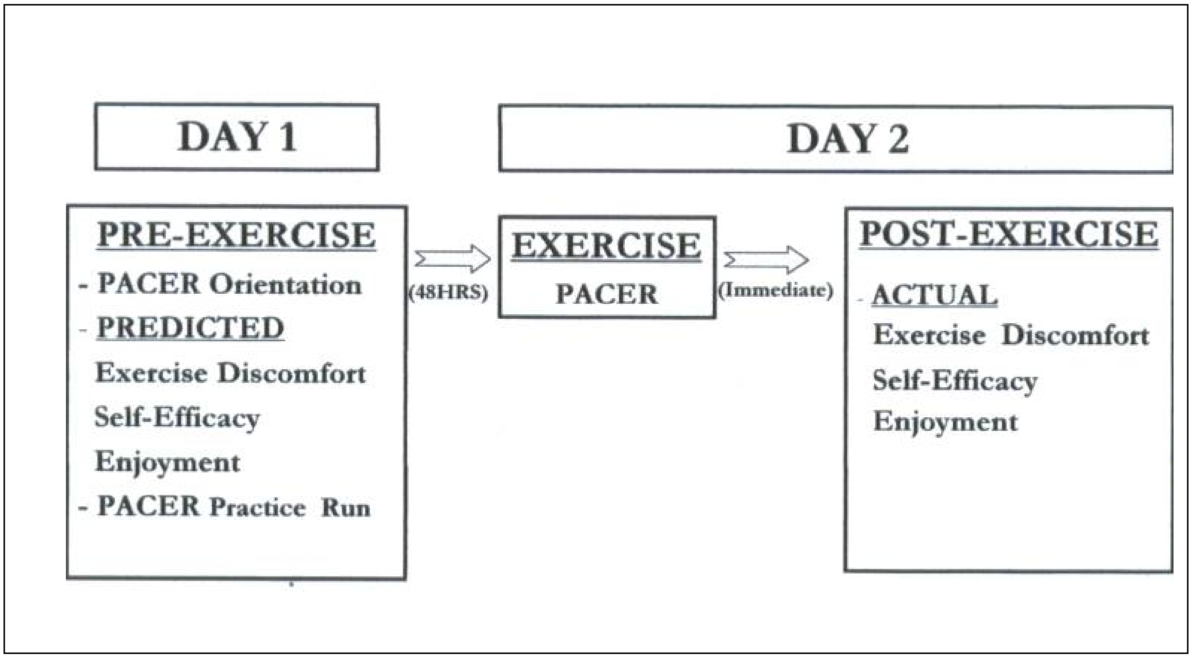


Figure 10: Research Design

Subjects completed the Physical Activity questionnaire one day prior to the PRE-EXERCISE assessment in their regular Physical Education class (20 minutes). The PRE-EXERCISE assessment required one Physical Education class period (40 minutes). Thirty four subjects were assessed during three class periods (6, 7 and 8^{th} grades). The PACER EXERCISE Test and POST-EXERCISE assessment were administered during a single 40 minute Physical Education class scheduled 48 hours following the PRE-EXERCISE assessment during the subjects' same Physical Education class. Total time for PRE-EXERCISE, EXERCISE, and POST-EXERCISE required approximately 80 minutes.

Female and male subjects who met the inclusion criteria and agreed to participate were randomly assigned to one of five PACER exercise groups within their respective Physical Education class. Subjects were sequentially assigned to their PACER exercise group within their physical education class until all subjects had a group assignment.

3.2.2 Setting and Scheduling

This research study was conducted in the gymnasium of Falk Laboratory School. The PRE-EXERCISE, EXERCISE, POST-EXERCISE schedule was coordinated with the school administrator and teacher liaison. Subjects were instructed to wear comfortable exercise clothing and athletic shoes appropriate for walking/running.

3.2.3 PRE-EXERCISE, POST-EXERCISE Components

I. Research Variables and Measurement

A) The *dependent* variables that were measured during the PRE-EXERCISE and POST-EXERCISE components of this research design (Figure 3.1) were as follows:

1 Predicted and actual exercise discomfort index (RPE x RMH) was measured using OMNI Scales (0-10) for exertion and muscle hurt.

a) The Children's OMNI Scale of Perceived Exertion: Walk/Run Format (Figure 11 and Appendix A) uses standardized instructions including definition and anchoring procedures (Appendix A.1) adapted from Robertson (143, 144).

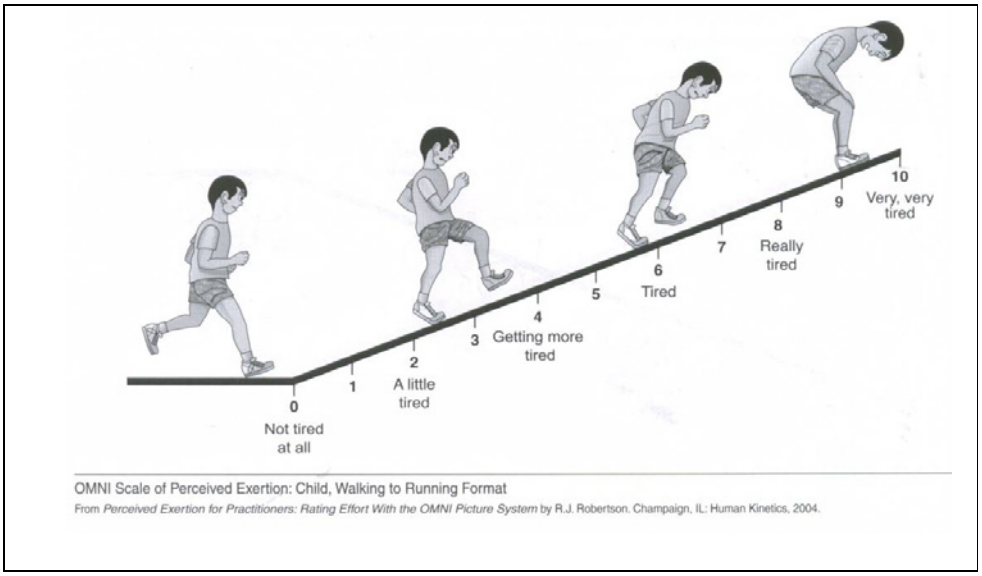


Figure 11: OMNI Scale of Perceived Exertion: Child Walk/Run Format
From R. J. Robertson, Perceived Exertion for Practitioners: Rating Effort with the OMNI Picture System. Champagne, IL: Human Kinetics, 2004, p. 146 (144).

The short instructional set is tailored to walk/run exercise and to the subject's age-related comprehension. The instructions establish a link between perceptual and physiological responses as exercise intensity increases consistent with the basic tenets of Borg's Effort Continua Model of Perceived Exertion (144). Instructions indicate that at a low exercise intensity, the feelings of exertion are linked to the lowest verbal and pictorial descriptors and numerical category on the scale. Conversely, at a high exercise intensity, the feelings of exertion are linked to the highest verbal and pictorial descriptors and numerical category on the scale. The low and high perceptual categories serve as anchor points to help the subject use the full scale response range. An *undifferentiated* rating of perceived exertion for the overall body (RPE-O) was obtained per standardized instructions (Appendix A.1). Predicted ratings of perceived exertion were obtained during PRE-EXERCISE assessment following viewing the PACER video. Actual ratings were measured during POST-EXERCISE assessment immediately following completion of the PACER test as recommended by Poulton et al. (132).

b) Subjects were also requested to rate their perception of leg muscle hurt (RMH) using the OMNI Scale of Muscle Hurt (Figure 12 and Appendix B) (145).

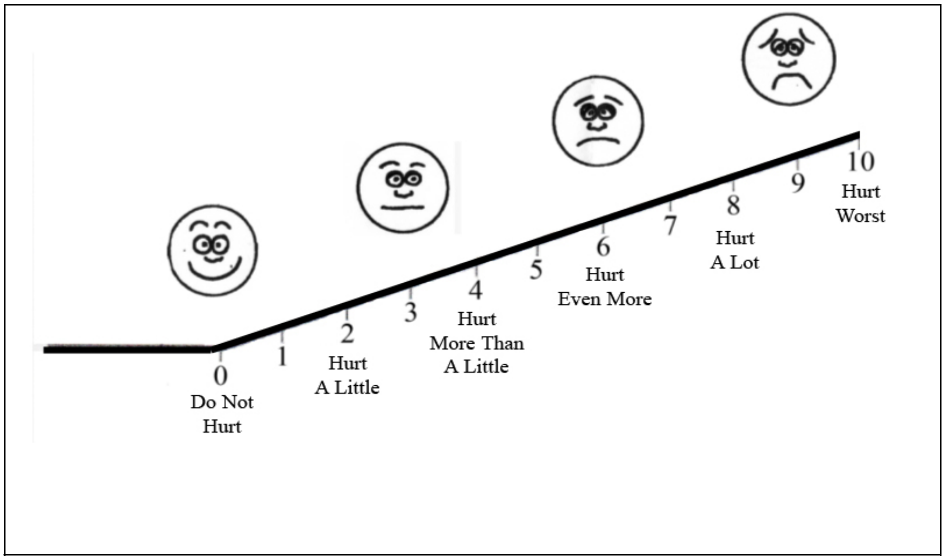


Figure 12: OMNI Scale of Muscle Hurt

From R. J. Robertson: Children's OMNI Scale of Muscle Hurt: Mixed Gender and Race Validation. In Press. (145)

Standardized instructions (Appendix B.1) including definition and anchoring procedures are adapted from directions previously developed for the OMNI Scale of Muscle Hurt during resistance exercise in children (144, 145). The short instructions are tailored to walk/run exercise and to the subject's age-related comprehension. These instructions indicate that when the leg muscles do not hurt the rating should be linked to the lowest verbal and pictorial descriptors and numerical category on the scale. Conversely, when the leg muscles hurt the worst, the rating should be linked to the highest verbal and pictorial descriptors and numerical category on the scale. The low and high hurt categories serve as anchor points to help the subject use the full scale response range.

Predicted ratings of muscle hurt were obtained during the PRE-EXERCISE assessment following viewing the PACER video and actual ratings of muscle hurt were measured during the POST-EXERCISE assessment immediately following completion of the PACER test as recommended by Poulton et al. (132). The rating of muscle hurt always followed the rating of perceived exertion.

The product of ratings for perceived exertion and hurt were calculated to determine the exercise discomfort index for the predicted and actual measurements, i.e. DI (discomfort index) = RPE x RMH. The product of RPE and RMH to determine the discomfort index was a calculation of choice in this initial study.

2 Pre-, and post exercise self-efficacy was measured using the Exercise Self-Efficacy Scale: Running.

The Exercise Self-Efficacy Scale: Running includes eleven PACER times representing consecutive minutes from 1 minute to more than 10 minutes. Each minute includes the number of laps to be run within that minute without stopping (Appendix C) (105, 150). Self-efficacy was scored on a 5-point Likert-response scale corresponding to each running time. Subjects rated their responses on the 5-point scale ranging from category 1 (Disagree a lot) to category 5 (Agree a lot). The self-efficacy scale accompanied by instructions (Appendix C) was administered on two separate occasions: 1) during the PRE-EXERCISE assessment following the PACER video and discomfort ratings and prior to PACER practice; and 2) during the POST-EXERCISE assessment immediately following the subject's discomfort ratings. The exercise self-efficacy score was calculated as the mean obtained by totaling the response for each item and dividing by eleven, the total number of items (31). A higher mean score represents a higher exercise self-efficacy indicating greater personal belief about the capability to perform the PACER shuttle run.

3 Pre-, and post exercise enjoyment was measured using the Physical Activity Enjoyment Scale for youth (PACES).

The Physical Activity Enjoyment Scale (PACES) has been modified for application to youth from its original version developed for college students (54, 84, 116). The rating scale, which was changed from a bipolar response format to a Likert-type response format for ease of use with youth, measures the single substantive factor of enjoyment (54).

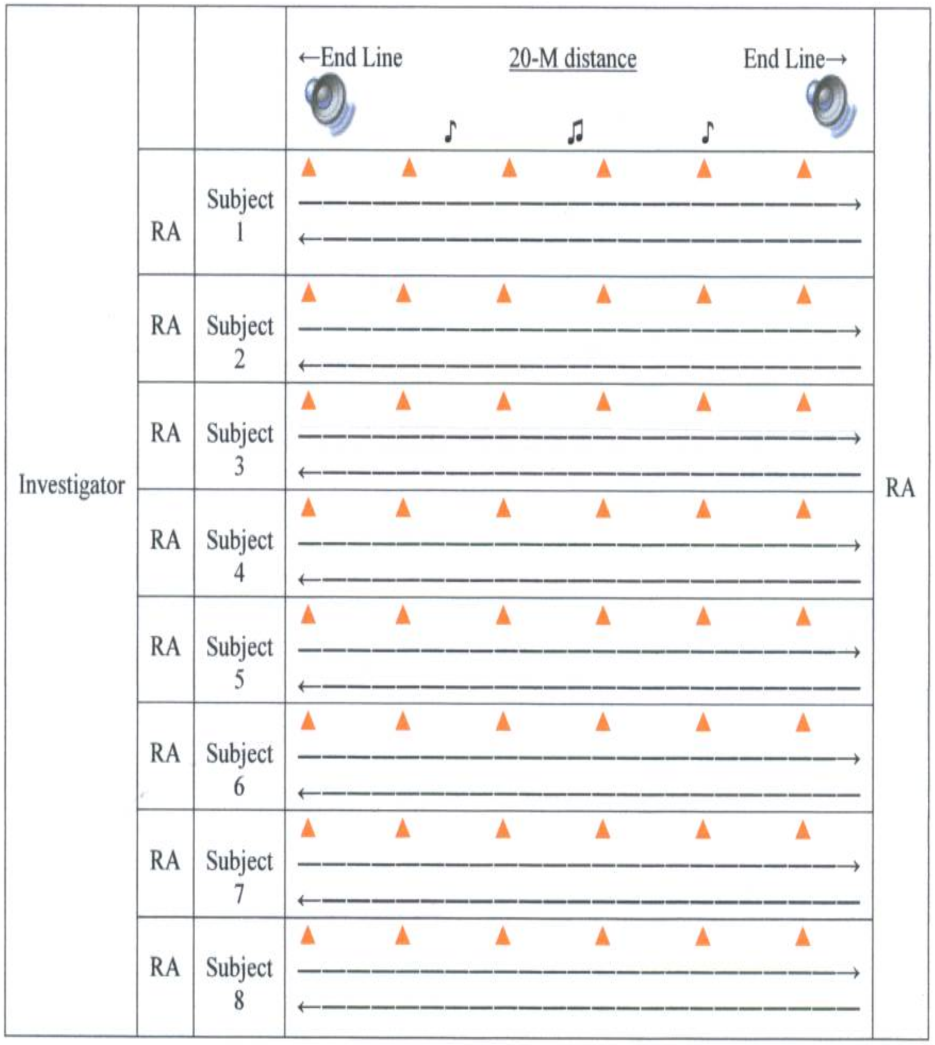
In the present study, subjects rated their enjoyment responses to running. The rating involved a 5-point scale ranging from category 1 (Disagree a lot) to category 5 (Agree a lot) for each of sixteen statements (Appendix D). The scale contains sixteen statements each of which has a corresponding 5-point response range. The sixteen statements are designed to eliminate possible methodological confounding effects that can occur with either positively or negatively worded items (54, 84, 116). The questionnaire with accompanying instructions (Appendix D) was administered on two separate occasions: 1) during the PRE-EXERCISE assessment immediately upon completion of the Running Self-Efficacy Scale; and 2) during the POST-EXERCISE assessment immediately upon completion of the Running Self-Efficacy Scale. The PACES score was the mean obtained by totaling the response for each item and dividing by the total number of items. A higher mean score represents higher exercise enjoyment denoting a greater personal belief about the exercise experience as ‘fun’.

3.2.4 PACER EXERCISE Test

1) PACER Test Description: The PACER 20-meter Multi-Level Fitness Test is administered using a CD with music and auditory beeps that accompany 21 levels (21 minutes) of progressively harder running (111). Each PACER running level requires approximately one minute for completion. The first level allows approximately nine seconds for each 20-meter lap and “the lap time decreases by approximately one-half second at each successive level” (111). The objective of the PACER is to ‘run as long as possible back and forth over the 20-meter lap at a specified pace that gets faster with each level (minute)’ (111).

When performing the PACER EXERCISE Test, each subject was assigned to a 40-inch width course lane (Figure 13). The lane assignment was determined by the subject’s numerical selection for group assignment, i.e., if selected first for group one, that subject was assigned lane one in group one; if selected second, the subject was assigned to lane two, group one and so forth. This process was used to assign lanes for each group of subjects.

The PACER test began with CD instructions that alerted the subject to the start of the TEST with the phrase “On your mark…get ready…START!”



RA (Research Assistant): 1 per Subject to count Laps/ obtain PACER RPE/RMH, Self-Efficacy and Enjoyment; 1-3 RA's to monitor End Line
▲: Lane Cone along with solid lines to demarcate 40 inch lanes for each subject

Figure 13: PACER Test Course

For a given subject, the test was concluded the second time that subject failed to reach one of the two end lines within their lane by the sound of the beep (18, 93, 98, 111). In addition, if the subject remained at one end of the testing area through two beeps, (i.e.., the subject did not run to the other end and back due to fatigue) that was scored as having two misses and the test was over (111). The last lap successfully completed was recorded on the PACER Score Sheet

(Appendix H) by research assistants who were assigned to monitor lap count for each subject (111).

2) PACER Test Score: The score for the PACER Exercise Test is the number of **completed laps** (Appendix H). The lap count for fifteen progressive levels is presented in Table 5 column one (111). PACER scores for subjects aged 10-14 years have been reported to range between 15-83 laps (18). Females have been reported to perform 15-51 laps or approximately 2-6 levels which takes 2-6 minutes; and, males have been reported to perform 23-83 laps or approximately 3-9 levels which takes 3-9 minutes (18). Laps are noted horizontally corresponding to each level (listed vertically in column one) in Table 5.

Table 5: PACER Levels with Corresponding Lap Count

Laps (20-meter lengths)

1	1	2	3	4	5	6	7							
2	8	9	10	11	12	13	14	15						
3	16	17	18	19	20	21	22	23						
4	24	25	26	27	28	29	30	31	32					
5	33	34	35	36	37	38	39	40	41					
6	42	43	44	45	46	47	48	49	50	51				
7	52	53	54	55	56	57	58	59	60	61				
8	62	63	64	65	66	67	68	69	70	71	72			
9	73	74	75	76	77	78	79	80	81	82	83			
10	84	85	86	87	88	89	90	91	92	93	94			
11	95	96	97	98	99	100	101	102	103	104	105	106		
12	107	108	109	110	111	112	113	114	115	116	117	118		
13	119	120	121	122	123	124	125	126	127	128	129	130	131	
14	132	133	134	135	136	137	138	139	140	141	142	143	144	
15	145	146	147	148	149	150	151	152	153	154	155	156	157	

From Meredith, M.D. & Welk, G. J. (Eds.) (2005) FITNESSGRAM, ACTIVITYGRAM: Test Administration Manual. Champaign, Ill: Human Kinetics, p. 93 (111).

The criterion-referenced standard for the estimated maximal aerobic power ($ml \cdot kg^{1} \cdot min^{-1}$) equivalent to the number of laps successfully completed is determined according to the Healthy Fitness Zones presented in the *FITNESS*GRAM® (Table 6) (18, 111). The

***FITNESS*GRAM®** uses a standardized equation to estimate maximal oxygen uptake (VO_2 max.) from the number of completed laps.

Table 6: FITNESSGRAM PACER Criterion Referenced Standards

Age	♀ #PACER laps	VO_2 max $ml \cdot kg^{-1} \cdot min^{-1}$ estimate	♂ #PACER laps	VO_2 max $ml \cdot kg^{-1} \cdot min^{-1}$ estimate
10	15 - 41	40 – 48	23 - 61	*42 - 52
11	15 - 41	39 – 47	23 - 72	42 - 52
12	23 - 41	38 – 46	32 - 72	42 - 52
13	23 - 51	37 – 45	41 - 72	42 - 52
14	23 - 51	36 – 44	41 - 83	42 - 52

(*The number on the left in the VO_2 max column represents the lower end of the Healthy Fitness Zone; the number on the right represents the upper end of the recommended zone).
Adapted from Baumgartner, T. A., Jackson, A. S., Mahar, M. T., & Rowe, D. A. (2007). Measurement for Evaluation in Physical Education and Exercise Science. Boston, MA: McGraw Hill. p. 346-347 (18).

The ***FITNESS*GRAM®** norms for laps and VO_2 max are used to describe aerobic fitness of the female and male subjects.

3.2.5 PACER PRE-EXERCISE Video

The procedures used to develop the PRE-EXERCISE PACER Video are presented in Appendix I.

3.2.6 PRE-EXERCISE, EXERCISE, POST-EXERCISE Script

1 PRE-EXERCISE Script: PRE-EXERCISE orientation employed the following script that was read to the subject:

A. WELCOME:

Subjects reported to the physical education area and were signed in. The following was read: "Welcome! Thank you for being a part of today's exercise testing. We'll start with an explanation of exactly what you will be doing today."

B. INSTRUCTIONS:

1. The **testing sequence** was briefly reviewed for the subjects:

"A quick look at what you will be doing over the next 40 minutes includes watching a short video to learn about a shuttle run called the PACER, predicting your feelings during the PACER run, and completing some forms that ask for information about running —we'll go over each form separately. Today you will also practice the PACER. In a couple of days, you will actually do the PACER test in this class. When you finish the PACER next time, you'll again report your feelings about the PACER and fill in the same forms. That's it! Any questions so far?" Questions were answered.

2. **PACER ORIENTATION**: "Let's talk about the shuttle run called the PACER that you will be doing. You will run in your own lane as part of your class group of runners. Those awaiting their test turn will be on the sideline with the teacher. When it's your turn to run you will line-up behind the start line in the lane number that matches the number you will be given".

[*The following script is adapted from the* ***FITNESS*****GRAM®** Administration Manual.]

"The objective of the PACER is to run as many times as possible back and forth across a lane marked for you. The pace you run follows along with the CD that is playing the music and sounding the beeps. Once the test starts, you will run in time to the music and beeps from one end of your lane to the other. This is called a lap. A single beep sounds at the end of time for each lap. You need to touch the end line with your foot by the time the beep sounds. At the sound of the beep, turn around and run back to the other end. If you get to the end line before the beep, STOP; and wait for the beep before running in the other direction. Continue running back and forth in your lane. Remember to run in a straight line. Do your best to run the full length of your lane before the next beep sounds"!

"One important point—a slightly different, longer-sounding beep will occur at the end of each minute. This beep sounds a little different but it means the same—it is just alerting you that the pace will get faster. The pace gets faster with each minute. So that means you have to run your lap faster each minute"!

The first time you do not reach the line by the sound of the beep, STOP where you are and reverse direction immediately to get back on pace with the music and the beeps. The next time that you cannot reach the line before the beep will be scored as your second miss. Misses do not have to occur in a row. When you have two misses, that is you cannot reach your end line two times before the beep sounds, the PACER is over for you. Also, if you just remain at one end of your lane through two beeps and do not run to the other end and back because you are tired, that is also two misses. Whenever you have two misses, just leave your lane and go to the side."

"When you do the actual PACER test in two days, an assistant will be there to direct you on what to do when you finish. That assistant will be counting how many laps you run". "One last point, remember that you may stop any time you choose to do so. If you have any unusual chest or leg pain at any time, please let the teacher, and assistant, or myself know and we will help you".

'Any questions so far?'

"The PACER CD begins with a man speaking. When I turn on the PACER CD, you will hear a voice that says the following":

"The ***FITNESSGRAM®*** PACER test is a multistage aerobic capacity test that progressively gets more difficult as it continues. The 20-M PACER test will begin in 30 seconds. Line up at the START. The running speed starts slowly, but gets faster each minute after you hear this signal [longer beep]. A single lap should be completed each time you hear this sound [shorter beep]. Remember to run in a straight line. And run as long as possible. The second time you fail to complete a lap before the sound, your test is OVER. The test will begin on the word 'START'. On your mark…get ready…START!"

"Any questions before I turn on the CD?"

"OK, now we'll listen to the PACER CD for 2 minutes and then we'll watch a video of the PACER. Then we'll go over questions".

3. Upon completion of the **PACER CD and PACER video** (Appendix I), the following was asked: "Any questions so far?" Following questions, RPE/RMH scales that comprise the Discomfort Index and the Running Self-Efficacy and Physical Activity Enjoyment questionnaires were presented and completed as follows.

4. The Discomfort Index was reviewed and measured as follows:

a) The instructions for the **OMNI Scale of Perceived Exertion for Children** were reviewed. Questions were answered. Predicted RPE was obtained as follows:

"Based on the PACER description you have received, I would like you to predict how tired you think you might feel when running the PACER. [Each subject will be given an OMNI RPE scale-Appendix A]. I am handing you a form with a picture of a person running up a hill. Please fill in your name where it says name. Then please listen carefully to the following instructions that I will read to you". (Appendix A.1)

“Definition of Exertion:

I am defining exertion as how tired your body feels during the PACER shuttle run.

Instruction:

Predicted RPE Instruction: I would like you to use the picture you have before you to describe how your body will feel during the PACER you just watched on video. Please use the numbers on this scale to tell me *how you think you will feel when you are running.* Please look at the person at the bottom of the hill who is just starting to run (*point to the left-hand picture*). If you think you will feel like this person looks when you run you will *not be tired at all*. You should select the number 0. Now look at the person who is barely able to run to the top of the hill (*point to the right-hand picture*). If you think you will feel like this person looks when you are running, you will be *very, very tired*. You should select the number 10. If you feel like you will be somewhere between *not tired at all* (0) and *very, very tired* (10), then give a number between 0 and 10. I will ask you to pick a number to tell how your overall body will feel.

There is no right or wrong number. Use both the pictures and the words to help you pick a number. Use *any* of the numbers to tell how your *overall body would feel* when running the PACER. Do you have any questions?” Please write the number in the blank space on your form below your name that tells how tired you think your *overall body will feel*.

Everyone ok? Great! Now I’ll collect your forms”.

b) The instructions for the Children’s OMNI Scale of Muscle Hurt were reviewed.

Questions were answered. Predicted RMH was then obtained:

“Also, I want you to predict how much hurt you think you will feel *in your leg muscles* while running the PACER. [Each subject will be given an OMNI RMH scale –Appendix B]. I am handing you a picture of faces. Please fill in your name on this form where it says name. Then please listen carefully to the following instructions that I will read to you". (Appendix B.1)

"Definition of Muscle Hurt:

I am defining muscle hurt as the amount or intensity of hurt that you ***may feel*** in your leg muscles during the PACER exercise.

Instructions:

Predicted RMH Instruction: I would like you to use the picture you have before you to describe how much you think your leg muscles might hurt during the PACER shuttle run. As we talked earlier, every minute, following the music and beeps, the run is set to go faster and be harder. Imagine that you are the smiling face on the left side of the picture who is just starting the run and whose leg muscles do not hurt at all. You would select a 0 on the picture. Now imagine that you are the un-smiling face on the right side of the picture who is barely able to run and whose muscles hurt the worst. You would select a 10 on the picture. If your leg muscles feel somewhere between Do Not Hurt (0) and Hurt the Worst (10), then select a number between 0 and 10. I will ask you to give a number that tells how you believe your leg muscles might hurt while running the PACER.

Remember, there is no right or wrong number. Use both the pictures and the words to help you select a number. Use *any* of the numbers to tell how you think your *leg muscles might hurt* when running. Do you have any questions?" You have a picture of faces before you. Please place the number in the space provided on the form that best predicts how your *leg muscles might hurt* when running the PACER. Everyone OK? Great! I'll collect the forms and we'll move on quickly to finish."

5. The Exercise Self-Efficacy Scale: Running and Physical Activity Enjoyment Scale (Appendices C and D) was reviewed, distributed for completion, and collected:

"Next we have two quick forms that have sentences on them that describe feelings you might have about running the PACER. I'll explain how to fill them out. We'll do them one at a time."

a) "What I am passing to you is **a form that asks how confident you are** about the amount of PACER time and laps you believe you can run. There are eleven different times listed according to minutes. Each minute also has the number of PACER laps that are completed within that minute. First please print your name and the date in the spaces provided.

OK, at the top of the page of this form you will see that it tells you to use the numbers 1 to 5 to give your answer. Number 1 means you disagree a lot with the running time and laps stated and number 5 means you agree a lot. Numbers 2, 3 and 4 give you a choice between disagree a lot and agree. Please carefully circle a number for each of the running times and laps that best describes what you believe you can run. Before you start the form, do you have any questions about what to do?"

The running self-efficacy forms were collected when the subjects are finished. The enjoyment questionnaires were then distributed.

b) "What I am passing to you is a **second form** that has 16 sentences. When you complete these sentences think about whether you will **enjoy, that is whether you will have fun,** when running the PACER. First please print your name and the date in the spaces provided. At the top of the page you will see that it tells you to use the phrase "When I run I…." before each numbered sentence. For example you would read sentence number one as "When I run I enjoy it". Then you would look at the numbers 1 to 5 next to the sentence and carefully circle the number that describes your response to what the sentence says. Number 1 means you disagree a lot with the sentence and number 5 means you agree a lot with the sentence. Numbers 2, 3 and 4 give you a choice between disagree a lot and agree. Before you start to read each sentence, do you have any questions about what to do? OK, please carefully circle a number that best describes your response."

The forms were collected when subjects were finished.

Subjects were then instructed: "Next time you will be asked to complete these same questionnaires *after* you run the PACER".

6. "That's it for instructions and forms! **Let's practice the PACER** before your next class." The subjects that were randomly assigned to the first group were instructed to line up (Figure 3.6). The second and third groups of subjects awaited their turn on the sideline. Subjects ran two practice laps as recommended in the ***FITNESS*GRAM®** Administration Manual (111).

"OK, you will be running with your assigned group at one time. Group number one—Let's line- up! The number you were assigned should match your lane number. If you have the number 1, please go to Lane 1, If you have the number 2 go to Lane 2, and so on. The numbers are taped on the wall behind the start line. Stand immediately behind the line".

"Remember as we said earlier—the pace you run should follow along with the CD that will be playing music and sounding beeps. The pace gets faster with each beep. Listen carefully to the CD instructions to "START". Then you run in time to the music from one end of your lane to the other end. Touch the line with your foot by the time the beep sounds. At the sound of the beep, turn around and run back to the other end. If you get to the line before the beep, STOP; and wait for the beep before running in the other direction. When you are done, move out of your lane and go to the sideline. When everyone is done, the next group will line up for their practice. Now that everyone is in place, first group get ready to run".

"Listen carefully to the CD instructions and be ready to run as soon as you hear 'on your mark…get ready…'START'. Then just run to the music and the beeps! OK, I'm turning on the CD; LISTEN and BEGIN YOUR RUN to the music when you hear the voice say 'on your mark…get ready…'START'.

9. **Finish**: When all of the subjects had an opportunity to practice the PACER, they heard: "We're done for today! Next time we'll do the PACER! Also, next time there will be assistants with me who will help you when you are done with the PACER to complete the same forms you did earlier. Any questions about today or next time?"

This ENDED the PRE-EXERCISE assessment.

2 PACER EXERCISE Test Script:

The PACER protocol and test instructions were directly adapted from the ***FITNESS*****GRAM®** Administration Manual (111). Research assistants who were instructed by the investigator on their role responsibilities were present to assist with the testing protocol. The PACER EXERCISE Test was performed in the Falk Laboratory School gymnasium. This gymnasium has a wooden floor and is regularly used for school physical education classes and sports.

The first group of subjects that performed the PACER during the PRE-EXERCISE assessment was instructed to line-up on the prepared course (Figure 3.6). The remaining subjects awaited their turn to perform the PACER on the course sideline with the teacher.

Research assistants were positioned behind the starting end line where they counted and recorded the laps completed by their assigned subjects using a lap scoring sheet (Appendix H). The procedure to record the completed laps on the score sheet is to "cross off each lap number" according to the ***FITNESS*GRAM®** Administration Manual (111). The completed count by the research assistant for each subject was the official recorded count.

The following script was read to the subjects. This text was adapted from the PRE-EXERCISE script.

A. "Welcome to our PACER testing day! Remember, as we said last time:

The objective of the PACER is to run as many times as possible back and forth across a lane marked for you. You'll run according to the pace of the CD music and beeps from one end of your lane to the other end. Listen to the sound of the beeps. You need to touch the end line with your foot by the time the beep sounds. At the sound of the beep, turn around and run back to the other end. If you get to the end line before the beep, STOP; and wait for the beep before running in the other direction. Continue running back and forth in your lane. Do your best to run your lane before the next beep sounds"!

When you have two misses, that is you cannot reach your end line two times before the beep sounds, the PACER is over for you. Just leave your lane and go to the side. An assistant will be there to help you rate your feelings and fill out the same forms as last time. That assistant will also be counting how many laps you run". 'Any questions so far?'

B. PACER EXERCISE Test: "OK, runners quickly report to position! Remember, your assigned number should match your lane number. If you have the number 1, please go to Lane 1, If you have the number 2 go to Lane 2, and so on".

"Now that everyone is in place, first group get ready to run! Listen carefully to the CD instructions and be ready to run as soon as you hear 'on your mark…get ready…'START'. Then just run to the pace of the music and the beeps! OK, the CD is starting; LISTEN and BEGIN YOUR RUN to the music when you hear the voice say 'on your mark…get ready…'START'.

The subjects performed their PACER. When all subjects from the first group completed their laps and moved out of the lanes, the second group was instructed to "Line Up" in preparation to perform the PACER. The final group of subjects remained with the teacher until the second group completed the PACER and moved out of the lanes. Then the final group was instructed to "Line Up".

Under the supervision of the research assistants, subjects finishing the PACER immediately completed the POST-EXERCISE assessments.

3 POST-EXERCISE Script:

Immediately following completion of the PACER, subjects completed the POST-EXERCISE discomfort ratings followed by the exercise self-efficacy and enjoyment questionnaires.

A. INSTRUCTIONS:

1. Discomfort Index: As soon as the subject completed her/his last lap, actual discomfort index ratings were obtained by the research assistant (Appendices A, A.1, B, B.1) as follows:

a) The research assistant reviewed the instructions for the Children's OMNI Scale of

Perceived Exertion with their subject. The research assistant then recorded the RPE-O reported by their assigned subject.

The POST-EXERCISE perceived exertion instructions were as follows:

"I am defining exertion as how tired your body felt during the PACER shuttle run. Please look at the picture of the person running up a hill. Use the numbers on this picture to tell me *how tired you actually felt when you ran.* Please look at the person at the bottom of the hill who is just starting to run. If you felt like this person looks when you ran you were *not tired at all*. You should select the number 0. Now look at the person who is barely able to run to the top of the hill. If you think you felt like this person looks when you ran, you were *very, very tired*. You should select the number 10. If you felt like you were somewhere between *not tired at all* (0) and *very, very tired* (10), then give a number between 0 and 10. There is no right or wrong number. Use both the pictures and the words to help you pick a number. I will ask you to pick a number to tell how your overall body *felt*. Use *any* of the numbers to tell how *your overall body felt* when running the PACER. Do you have any questions?" Please select the number that tells how tired your *overall body felt* when running the PACER.

b) The instructions for the Children's OMNI Scale of Perceived Hurt were reviewed with the subject by the research assistant. The research assistant then recorded the RMH reported by their assigned subject.

The POST-EXERCISE instructions were as follows:

"I am defining muscle hurt as the amount or intensity of hurt that you *did feel* in your leg muscles during the PACER exercise. Please use the picture before you to describe how much your leg muscles hurt during the PACER shuttle run. Imagine that you are the smiling face on the left side of the picture and whose leg muscles <u>did not hurt</u>. If your leg muscles <u>did not hurt</u>, select the number 0 on the picture. Now imagine that you are the un-smiling face on the right side of the picture whose muscles <u>hurt the worst</u>. If your leg muscles <u>hurt the worst</u>, select the number 10 on the picture. If your leg muscles felt somewhere between Do Not Hurt (0) and Hurt the Worst (10), then say a number between 0 and 10. I will ask you to give a number that tells how your <u>*leg muscles did hurt*</u> while running the PACER. Remember, there is no right or wrong number. Use both the pictures and the words to help you say a number. Do you have any questions? Use *any* of the numbers to tell how your <u>*leg muscles did hurt*</u> when running the PACER".

2. The POST-EXERCISE assessment sequence was the same as employed for the PRE-EXERCISE assessment. Upon completion of the RPE/RMH ratings, the assistant immediately directed the subject to complete the **Exercise Self-Efficacy**: **Running** questionnaire (Appendix C). Instructions for completion were:

"This form contains the same eleven items you responded to the last time. Please write your name on the form. *Carefully circle a number from 1 to 5 for each of the minute and lap sentences to indicate how confident you felt running the PACER*. Number 1 means you disagree a lot with the minutes and laps stated; number 5 means you agree a lot." A research assistant was available to answer questions, collect forms and assure their completion.

3. Subsequent to completion of the Running Self- Efficacy form, the research assistant provided the **Physical Activity Enjoyment (PACES) form** for completion (Appendix D). The instructions for completion were:

"Please write your name on the form. This form contains the same 16 sentences that you responded to the last time. *Carefully circle a number from 1 to 5 for each of the 16 sentences to indicate how much you enjoyed running*. Number 1 means you disagree a lot with the sentence and number 5 means you agree a lot."

A research assistant was available to answer questions, collect forms and assure their completion. When subjects finished PACER testing *and* completed their ratings/questionnaires, they then moved to the designated sideline where they were supervised by the teacher.

4. Subjects were thanked for their participation when they completed the POST-EXERCISE assessment. Results of their PACER performance will be individually distributed to the participants at a date designated by the researcher and teacher.

3.3 DATA ANALYSIS

Descriptive statistics for all variables are reported by gender and age as well as for the total sample. Height, weight, BMI, physical activity habits, sport participation, and completed PACER laps with estimated VO_{2max} are reported as means ± standard deviation.

Statistical analyses for the main dependent variables include:

Hypothesis I:

Differences between predicted and actual exercise discomfort, pre-, and post self-efficacy and enjoyment were statistically examined using a dependent samples t-test. A one tailed-test was used with the level of statistical significance set at $p < 0.05$.

Hypothesis II:

Pearson correlation coefficients were used to examine the relation between 1) predicted exercise discomfort and pre-exercise self-efficacy and enjoyment; 2) actual exercise discomfort and post-exercise self-efficacy and enjoyment (Table 7). A one tailed-test was used with the level of statistical significance set at $p < 0.05$.

In addition to the relations between variables addressed in Hypothesis II, Pearson correlation coefficients were computed between the variables listed in Table 7.

Table 7: Correlational Matrix

Variables	Predicted Discomfort	Pre- Self-Efficacy	Pre- Enjoyment	Actual Discomfort	Post- Self-Efficacy	Post- Enjoyment
Predicted Discomfort		II	II	*	*	*
Pre- Self-Efficacy			*	*	*	*
Pre- Enjoyment				*	*	*
Actual Discomfort					II	II
Post- Self-Efficacy						*
Post- Enjoyment						
LAPS	*	*	*	*	*	*

Key: II = Variable relations in Hypothesis II; * = Variable relations explored in secondary analysis

A Bland-Altman plot was constructed to represent the relation of discrepancy between predicted and actual ratings of discomfort to the average of the predicted and actual ratings of discomfort. Analyses were conducted to explore whether over-under predictors differed with respect to physical activity and sport participation level, PACER laps completed, BMI, or age.

Data (Appendix G) was analyzed using SPSS Version 14.0 for Windows (SPSS, Inc., Chicago, IL).

4.0 RESULTS AND DISCUSSION

4.1 INTRODUCTION

The objective of this investigation was to use a match-mismatch paradigm to examine three psychological constructs that potentially operate as barriers to influence children's beliefs about participation in an aerobic physical activity. Exercise discomfort (i.e., perceived exertion and muscular hurt), self-efficacy, and enjoyment were examined for 34 Falk Middle School children (11 to 14 years old), prior to and immediately following participation in a standardized submaximal field exercise test for aerobic fitness, the PACER shuttle run (111).

4.2 PREDICTED AND ACTUAL EXERCISE DISCOMFORT

Presented in Table 8 are the means ± SD for predicted and actual exercise discomfort data for the total, female and male groups. A summary of the *t* tests for mean differences between predicted and actual responses is also presented.

Table 8: Predicted and Actual Exercise Discomfort Ratings

Variable	Group	n	Predicted Mean	± SD	Actual Mean	± SD	*t*	Sig. (1-tailed)
Exercise Discomfort	Total	34	25.97	20.08	19.38	17.82	2.49	0.009
	Female	18	31.53	21.63	24.00	22.15	1.83	0.042
	Male	16	19.38	16.34	14.19	9.40	1.68	0.057

The paired sample *t* test indicated that the predicted discomfort was greater than the actual discomfort for the total group (p = .009) and the female group (p =.042). The difference between predicted and actual exercise discomfort was not statistically significant for the males.

A Bland-Altman plot was constructed to examine limits of agreement between predicted and actual ratings of discomfort for the total group (Figure 14).

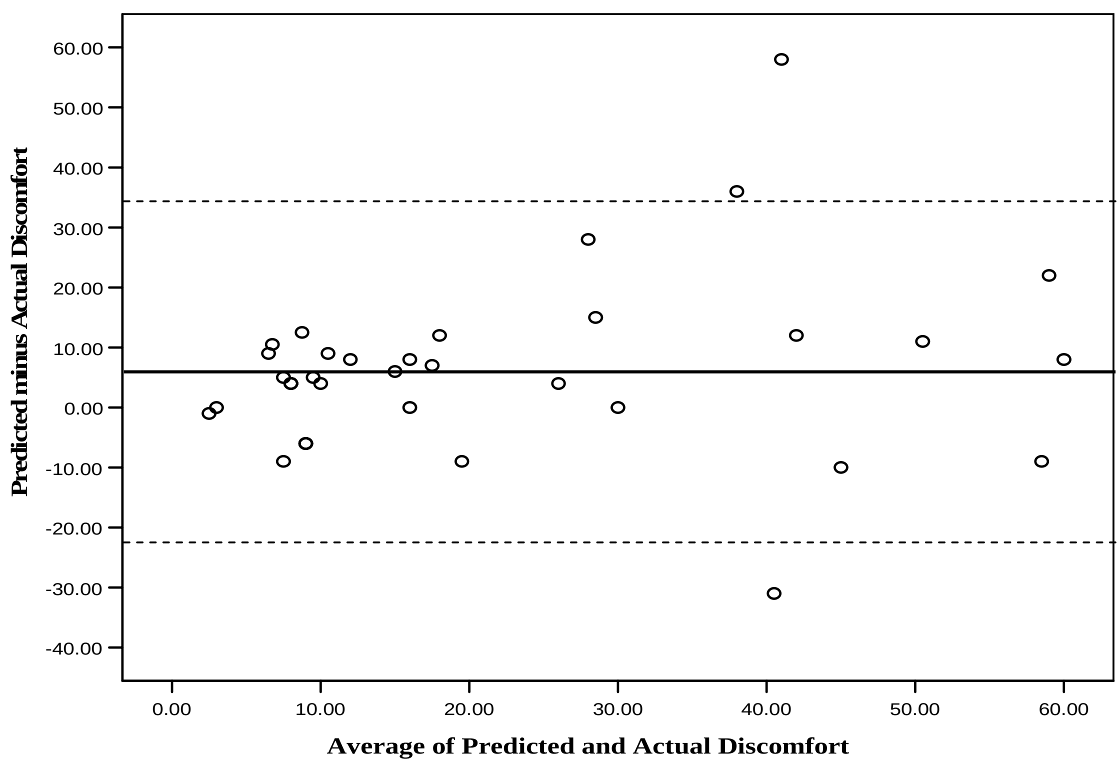


Figure 14: Limits of Agreement between Predicted and Actual Discomfort Ratings

The *x* axis in Figure 14 presents the mean of the rating of predicted discomfort and the rating of actual discomfort. The *y* axis presents the difference between predicted and actual discomfort ratings. The solid horizontal line indicates the mean difference of 6.38. The dashed lines above and below the solid line indicate the upper and lower 95% confidence interval for the mean difference. The upper limit fell at 35. 68 and the lower limit fell at 22.92. The comparatively large width of the confidence intervals indicates poor agreement between predicted and actual discomfort for the total group. It can also be seen in Figure 4.1 that variability increases as the mean predicted and actual discomfort rating increases.

Presented in Table 9 are the means± SD for the predicted and actual RPE and RMH data that were used to compute the Exercise Discomfort Index. Data are listed for the total, female and male groups. A summary of the *t* tests for mean differences between predicted and actual responses is also presented.

Table 9: Predicted and Actual Components of Exercise Discomfort: RPE and RMH

Variable	Group	n	Predicted Mean	± SD	Actual Mean	± SD	*t*	Sig. (1-tailed)
RPE	Total	34	5.94	1.98	6.03	1.78	-0.23	0.410
	Female	18	6.77	1.48	6.33	1.97	1.08	0.150
	Male	16	5.00	2.12	5.69	1.54	-1.67	0.060
RMH	Total	34	3.98	2.28	2.93	2.13	3.13	0.002
	Female	18	4.45	2.52	3.31	2.57	2.11	0.025
	Male	16	3.42	1.87	2.50	1.49	2.38	0.015

RPE: Rating of Perceived Exertion. RMH: Rating of Muscle Hurt

The paired sample *t* test indicated that Predicted and Actual RPE did not differ for the total group, or for the female and male groups when examined separately. In contrast, *t* test indicated that Predicted RMH was greater ($p<0.05$) than the Actual RMH for the total, female, and male groups.

4.3 PRE-, POST-EXERCISE SELF-EFFICACY

Presented in Table 10 are the means± SD for pre-, and post-exercise self-efficacy data for the total, female and male groups. A summary of the *t* tests for mean differences between pre-, and post-exercise responses is also presented.

Table 10: Pre-, and Post-Exercise Self-Efficacy

Variable	Group	n	Pre-Exercise Mean	±SD	Post-Exercise Mean	±SD	*t*	Sig. (1-tailed)
Exercise Self-Efficacy	Total	34	2.67	0.73	2.26	0.67	4.58	<0.001
	Female	18	2.24	0.45	1.97	0.56	2.47	0.012
	Male	16	3.15	0.66	2.59	0.65	4.11	<0.001

The paired sample *t* test indicated that the pre-exercise ratings of self-efficacy were significantly higher than post-exercise ($p = 0.001^2$) for the total, female and male groups. Results indicated a response *mismatch* which was not consistent with the hypothesis.

4.4 PRE-, POST-EXERCISE ENJOYMENT

Presented in Table 11 are the means ± SD for pre-, and post-exercise enjoyment data for the total, female and male groups. A summary of the *t* tests for mean differences between pre-, and post-exercise responses is also presented.

Table 11: Pre-, and Post-Exercise Enjoyment

Variable	Group	n	Pre-Exercise Mean	±SD	Post-Exercise Mean	±SD	*t*	Sig. (1-tailed)
Exercise Enjoyment	Total	34	3.41	0.89	3.39	0.66	.251	0.400
	Female	18	3.36	0.85	3.26	0.62	.902	0.190
	Male	16	3.45	0.78	3.52	0.70	-.822	0.212

The paired sample *t* test indicated no significant differences between pre-exercise and post-exercise ratings of enjoyment for the total, female and male groups. Results indicated a response *match* rather than the hypothesized mismatch.

4.5 INTERRELATIONS BETWEEN PREDICTED AND ACTUAL EXERCISE DISCOMFORT, SELF-EFFICACY AND ENJOYMENT

Presented in Table 12 are the interrelations between predicted and actual exercise discomfort, pre-, and post-exercise self-efficacy, and pre-, and post-exercise enjoyment. Pearson correlations are presented for the total, female and male groups.

Table 12: Exercise Discomfort, Self-Efficacy and Enjoyment Interrelations

	Pearson Correlation	Predicted Exercise Discomfort	Actual Exercise Discomfort	Pre-Exercise Self-Efficacy	Post-Exercise Self-Efficacy	Pre-Exercise Enjoyment	Post-Exercise Enjoyment
Predicted Exercise Discomfort	Total [1]	1	.701**	-.214	-.226	.208	.222
	Female[2]		.699**	.076	-.177	.186	.289
	Male[3]		.660**	-.143	-.009	.321	.337
Actual Exercise Discomfort	Total		1	-.207	-.277	-.016	-.083
	Female			.123	-.158	-.035	-.129
	Male			-.349	-.272	.099	.199
Pre-Exercise Self-Efficacy	Total			1	.720**	.064	.115
	Female				.602**	.069	-.097
	Male				.644**	.013	.035
Post-Exercise Self-Efficacy	Total				1	.228	.302*
	Female					.150	.075
	Male					.316	.384
Pre-Exercise Enjoyment	Total					1	.850**
	Female						.840**
	Male						.887**
Post-Exercise Enjoyment	Total						1

** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).
1 n = 34; 2 n= 18; 3 n= 16

A strong and significant positive correlation was found between predicted exercise discomfort and actual exercise discomfort for the total (r = .701, p = .000), female (r = .699, p = .001), and male (r = .660, p = .003) groups. These data indicated that subjects who expected more discomfort reported more discomfort at the post-exercise measurement point. Similarly, a strong and significant positive correlation was also noted between pre-, and post-exercise self-efficacy for the total (r = .720, p = .000), female (r = .602, p = .004) and male (r = .644, p = .004) groups. These data indicated that subjects who had higher self-efficacy prior to exercise generally reported higher self-efficacy post-exercise. The strongest relations were noted between pre-, and post-exercise enjoyment for the total (r = .850, p = .000), female (r = .840, p

= .000) and male (*r* = .877, *p* = .000) groups. These data indicated that subjects with higher ratings of enjoyment prior to exercise reported higher enjoyment post-exercise.

Only one significant positive correlation was found *between* the main variables. A moderately strong and significant positive relation between post-exercise self-efficacy and post-exercise enjoyment was observed in the total group (*r* = .302; *p* = .041). These data indicated that subjects who reported greater enjoyment of the PACER also tended to report greater self-efficacy when assessments were made following exercise performance.

4.6 DISCOMFORT PREDICTIONS AND DEMOGRAPHIC CHARACTERISTICS

Idiograph analysis allowed the identification of those subjects who either over-or under-predicted discomfort compared to their actual discomfort ratings. Underprediction of discomfort was defined as a lower predicted than actual discomfort response. Overprediction of discomfort was defined as a higher predicted than actual discomfort response. Figure 15 displays the distribution of individuals who overpredicted discomfort. The diagonal line represents equality between predicted and actual values. The three circles that fall exactly on the line represent the 3 subjects (1 female; 2 males) whose predicted and actual discomfort ratings were the same. Circles that fall above the diagonal line represent the 23 subjects (14 females; 9 males) who overpredicted discomfort while circles that fall below the diagonal line represent 8 subjects (3 females; 5 males) who underpredicted discomfort.

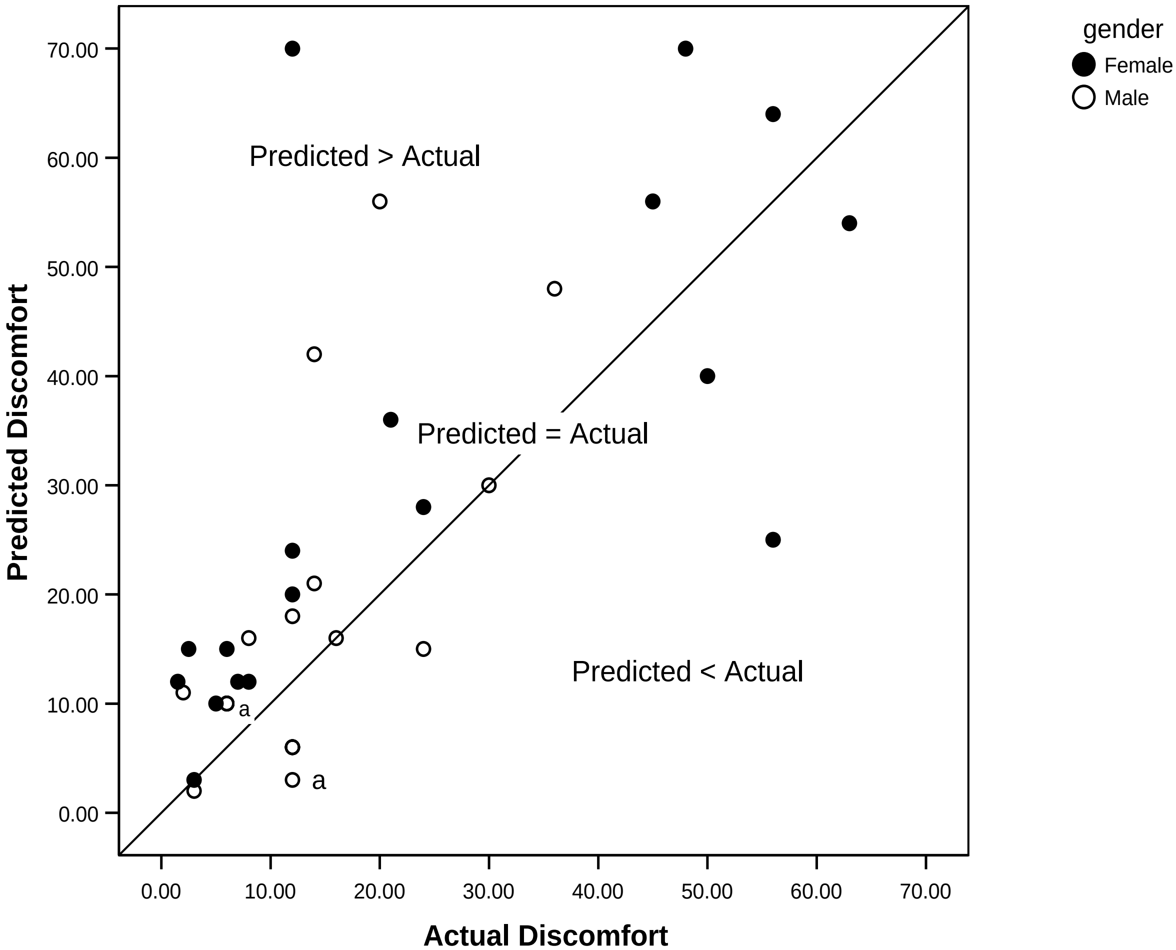


Figure 15: Distribution of Over and Under-Predictors of Exercise Discomfort
(a: represents 2 subjects)

Those subjects who either over or underpredicted discomfort were in turn examined by age, BMI, PACER LAPS completed, and physical activity and sport participation level. Presented in Tables 13 and 14 are the results of independent samples *t* tests employed for the total group to address the question of whether subjects who overpredicted discomfort differed from subjects who underpredicted discomfort with respect to selected demographics.

Table 13: Over, Under-Discomfort Predictions according to Age, BMI, Laps, PA

Variable	Prediction Status	n	Mean	SD	*t*	*p*
Age (Yrs)	Under	8	12.84	0.79	1.103	.279
	Over	23	12.43	0.94		
BMI (kg/m^2)	Under	8	19.39	3.37	-.265	.793
	Over	23	19.78	3.67		
LAPS (# completed)	Under	8	26.75	8.67	.670	.508
	Over	23	23.83	11.19		

Table 14: Over, Under-Discomfort Predictions according to Physical Activity

Activty		Under Prediction		Over Prediction			
		n	%	n	%	Chi-Square	*p*
Days of Hard Exercise	5 or less	2	25.0	11	47.8	1.270	.260
	6 or more	6	75.0	12	52.2		
Days of Light Exercise	5 or less	2	25.0	8	36.4	0.341	.559
	6 or more	6	75.0	14	63.6		
TV, Video, Computer Hours	Less than 4	7	87.5	20	87.0	0.002	.968
	4 or more	1	12.5	3	13.0		
Competitive Activities	None	1	12.5	5	21.7	0.325	.569
	1 or more	7	87.5	18	78.3		
						Mann-Whitney U	
Leisure PA Hours/Week	Mean Rank	21.75		14.00		46.00	.038
	Median	11.14		5.25			

Significant differences were found for only one variable, hours of leisure PA per week (p = .038). Subjects who underpredicted exercise discomfort reported a median of 11.14 hours/week of recreational activity. Those subjects overpredicting exercise discomfort reported a median of 5.25 hours/week of recreational activity. Neither age, BMI, PACER LAPS completed, nor other PA measures differed between over and under predictors of exercise discomfort.

4.7 EXERCISE SELF-EFFICACY, ENJOYMENT AND LAPS

Pearson correlations were computed for the total, female and male groups to examine the relations between the number of PACER laps completed and both pre-, and post-exercise self-efficacy and pre-, and post-exercise enjoyment, respectively (Table 15).

Table 15: Correlations between Exercise Self-Efficacy, Enjoyment and Laps

		Laps Completed
Pre-Exercise Self-Efficacy	**Total [1]**	**.582****
	Female[2]	**.448***
	Male[3]	**.464***
Post-Exercise Self-Efficacy	**Total [1]**	**.703****
	Female[2]	**.653****
	Male[3]	**.634****
Pre-Exercise Enjoyment	**Total [1]**	**.118**
	Female[2]	**-.074**
	Male[3]	**.256**
Post-Exercise Enjoyment	**Total [1]**	**.125**
	Female[2]	**-.292**
	Male[3]	**.274**

** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).
1 n = 34; 2 n= 18; 3 n= 16

Moderate to strong positive correlations were noted between PACER laps and both pre- (r = .582; p = .000) and post- (r = .703; p = .000) exercise self-efficacy in the total group. Similar correlations were observed in the female group (pre: r = .448; p = .031; post: r = .653; p = .002) and the male group (pre: r = .464; p = .035; post: r = .634; p = .004). No significant correlations were found between either pre-, or post-exercise enjoyment and PACER laps in any group.

4.8 PACER EXERCISE TEST

The number of completed PACER laps for the total, female and male groups are presented in Table 16 along with National PACER Standards for lap performance and estimated VO_2 max ($ml \cdot kg^{-1}$ min^{-}) (18).

Table 16: PACER Laps Completed compared to National PACER Standards

Age (Yrs)	Group	n	Completed PACER Laps					National Standard PACER laps	National Standard VO_2 max ($ml \cdot kg^{-1} \cdot min^{-1}$) estimate
			Median	Mean	SD	Min.	Max.		
11-14	Total	34	25.50	25.35	10.59	10	56	15-83	36-52
	Female	18	19.50	21.39	7.66	10	35	15-51	36-47
	Male	16	29.50	29.81	11.74	10	56	23-83	42-52
11	Total	10	16.50	19.30	8.94	10	38	15-72	39-52
	Female	7	17.00	19.14	5.98	13	30	15-41	39-47
	Male	3	11.00	19.67	15.88	10	38	23-72	42-52
12	Total	10	27.00	29.70	10.79	18	56	23-72	42-52
	Female	3	26.00	26.33	7.50	19	34	23-41	38-46
	Male	7	28.00	31.14	12.15	18	56	32-72	42-52
13	Total	10	28.50	28.70	10.37	10	43	23-72	37-52
	Female	4	21.00	21.75	11.02	10	35	23-51	37-45
	Male	6	32.50	33.33	7.50	25	43	41-72	42-52
14	Female	4	18.50	21.25	8.09	15	33	23-51	36-44

Mean PACER laps for the total, female and male groups were within the recommended National Standard range. However, the large standard deviations indicated wide variation in shuttle run performance. Within the total group, the number of competed PACER laps for ages 11, 12 and 13 fell within the National Standard range. For the females, the 11 and 12 year olds met the recommended standards, while the 13 and 14 year olds were slightly below the National Standard range. Males of all ages were slightly below the National Standard range for completed laps.

4.9 DISCUSSION

4.9.1 Exercise Discomfort, Self-Efficacy and Enjoyment: Match-Mismatch

This investigation used a match-mismatch paradigm to study predicted and actual exercise discomfort, pre-, and post-exercise self-efficacy and pre-, and post-exercise enjoyment in a sample of 11-14 year old female and male children. Measures were obtained prior to and following performance of an aerobic shuttle run of increasing intensity, i.e., the PACER.

Hypothesis I stated that 1) predicted exercise discomfort would be greater than actual exercise discomfort; 2) pre- exercise self-efficacy would be less than post- exercise self-efficacy; and 3) pre- exercise enjoyment would be less than post- exercise enjoyment.

4.9.1.1 Exercise Discomfort

Data for the total group indicated an *overprediction* (p = 0.009) of exercise discomfort. That is, the predicted discomfort level was higher than that actually experienced. This finding was consistent with Research Hypothesis I stating that predicted discomfort would be greater than actual discomfort. Group means for both the predicted (25.97 ± 20) and actual (19.38 ± 18) discomfort index fell in the lower portion of the possible response range (i.e., 0-100). The low means observed were likely a function of the moderate, sub-maximal exercise intensity that was required to perform the PACER shuttle run.

The Bland-Altman plot for the total group examined the limits of agreement between predicted and actual discomfort ratings. Upper and lower limits were 35.68 and 22.92 respectively. It would be expected that 95% of the computed difference values for discomfort (i.e., predicted minus actual) would fall between these limits. Since the lower limit of agreement was considerably greater than zero, overprediction of discomfort in the great majority of cases would be expected. Thus, these idiographic results provided further evidence that subjects predicted a greater level of discomfort than was actually experienced when performing a sub-maximal shuttle run.

Employing the match-mismatch paradigm to examine predicted and actual exercise discomfort of middle school children performing the PACER shuttle run was consistent with paradigms used in previous research. The findings observed presently for 11-14 year old children were generally similar to those reported by Poulton et al. for young adults (132). Using a cycle ergometer protocol, Poulton et al. compared pre-exercise predictions of 'undefined' discomfort ("How much discomfort do you anticipate experiencing?") with post-exercise reports for a mixed gender sample of young adults (132). Both overprediction and underprediction of exercise discomfort were observed. It was postulated that overprediction of exercise discomfort may function as a barrier to physical activity participation in young adults. Interestingly, Poulton et al. reported that young adult females overpredicted exercise discomfort; whereas, young adult males underpredicted exercise discomfort. When gender data were separately examined in the current study, female subjects significantly o*verpredicted* (p = 0.042) exercise discomfort (predicted mean: 31.53 ± 21.63; actual mean: 24.0 ± 22.15), supporting Hypothesis I. However, in contrast to the Poulton et al. findings, significant differences in discomfort ratings were *not* noted for male subjects. There was, however, a non-significant trend toward *overprediction* of discomfort in the male children.

As noted earlier, Poulton et al. used the term “undefined” discomfort in conjunction with exercise participation. The current study expanded the work of Poulton et al. by operationally defining exercise discomfort as the product of a rating of perceived exertion (RPE-O) and a rating of leg muscle hurt (RMH). The predicted and actual RPE-O and RMH variables that comprise the exercise discomfort index were analyzed separately for the total group. This analysis examined the comparative importance of both exertion and hurt ratings in determining match-mismatch responsiveness. Statistical analysis for total group data indicated that predicted and actual RPE-O did not differ. The subjects’ predicted (5.94 ± 2) and actual (6.03 ± 2) RPE-O were very similar to the *group normalized* RPE of 6 (OMNI Scale) that generally corresponds to anaerobic threshold as measured by the ventilatory breakpoint (144). This threshold marks ‘an appropriate overload stimulus to improve aerobic fitness’ (144). Thus, the RPE-O data suggested that subjects in the current investigation performed near their anaerobic threshold for a period of time during the PACER. Because intensities equal to or above the anaerobic threshold usually evoke noxious perceptions that intensify RPE, it might be concluded that the exercise intensity of the PACER was adequate to produce exercise related discomfort.

On the other hand, the group mean predicted RMH was greater ($p = 0.002$) than actual RMH (predicted: 3.98 ± 2; actual 2.93 ± 2). Muscle hurt was significantly *overpredicted* resulting in a response *mismatch*. This was consistent with the clinical research of Rachman and Arntz who reported that individuals generally ‘overpredict the pain they will experience’

(135). Studies of exercise-induced muscle pain have primarily been conducted with young adults. A previous study in which participants performed cycle ergometry reported mean values ranging from 4.2 at moderate intensity to 8.2 at peak intensity using a 0-10 category-ratio scale developed by the authors (37). The total group RMH for the present study also fell in the approximate mid-range of the Muscle Hurt Scale, i.e., 3.98 ± 2. This is consistent with previous reports of pain responsiveness during moderate intensity aerobic exercise in young adults.

Predicted and actual RPE and RMH were also examined separately for females and males. The predicted and actual RPE-O were not statistically different indicating a response *match* for both male ($p = 0.060$) and female ($p = 0.15$) subjects. Although Robbins et al. did not employ a match-mismatch paradigm in their laboratory treadmill study with 9-17 year old children; they reported RPE responses for female and male subjects similar to those observed in the present study. In contrast, RMH was *significantly* overpredicted by both female and male subjects in the present study resulting in a response *mismatch*. The higher predicted than actual RMH findings for females in the present study were consistent with two clinical studies of *arm pain* in children undergoing venipuncture procedures (61, 91). However, these previous studies indicated that male children underpredicted pain whereas males in the present study overpredicted exercise-related pain. The main point emphasized in these previous investigations was the need to develop strategies to assist children in making accurate pain predictions (91). Children evidenced good recall for experiences associated with painful events (174). 'Preparing children for a proposed experience with accurate and credible information at their level of understanding' is critical to making accurate predictions (174, 183). Such preparation could prevent avoidance of future experiences based upon inaccurate perceptions regarding expected pain sensations (91, 131, 174, 183).

Combining RPE and RMH in the current study to create an exercise discomfort index was intended to provide a more robust measure of the sensory milieu during aerobic exercise (144). The index could potentially assist children in learning a more accurate 'prediction adjustment' regarding an ensuing *aerobic exercise* experience (43, 132, 174). The present findings are consistent with previous research that stated "exercise induced pain and exertional perception are distinct sensory domains that occur more or less simultaneously during exercise" (144). The separate components of the discomfort index indicated that middle school female and male children a) *accurately* predicted the overall body exertion that would be experienced; and, b) *inaccurately overpredicted* muscle hurt while performing the PACER shuttle run. From these findings it is proposed that the perception of muscle hurt was the primary factor in shaping the predicted level of discomfort for aerobic exercise. The naturally occurring skeletal-muscle hurt intensified with the increasing exercise intensity (27, 37, 144). Extrapolating from Cook et al. observations, the overprediction of muscle hurt in the present study occurred in the presence of accurate predictions of exertional perceptions (37). The combined effect of the two perceptual measures (hurt and exertion) resulted in an overprediction of exercise related discomfort. Thus, discomfort prediction may operate as a potential barrier to participation in aerobic activity by both female and male children.

Based on the present findings, it is proposed that the discomfort index (RPE-O x RMH): 1) provided a metric to objectively assess a previously undefined but widely used perceptual assessment of exercise related sensations; and, 2) substantiated the premise that exertion and muscle hurt are parallel perceptual constructs that influence children's *discomfort* *perceptions* about aerobic exercise. As such, anticipated discomfort may function as a barrier to aerobic exercise participation. Specifically, it was hypothesized that exercise discomfort operated as a psychological barrier for middle school children performing a common aerobic activity. This conclusion held when data were examined for the total group and the female group. With respect to the male children, the findings did not support exercise discomfort as a psychological barrier; however, an overprediction trend was noted. These findings reinforced the research of Sallis et al. who proposed that the presence of 'perceived barriers' is the most consistent factor associated with low levels of physical activity participation by children. Finally, the results for the total and gender specific groups supported Poulton et al. observation that 'employing the prediction match-mismatch paradigm may be useful for investigation of factors associated with the initiation of exercise' (132, 135).

4.9.1.2 Exercise Self-Efficacy

The mean pre-exercise self-efficacy score was greater than the post-exercise self-efficacy score for both the female and male children. The findings indicated a *statistically significant response mismatch* ($p < 0.05$). As such, the results did *not* support the hypothesis that subjects' pre-exercise rating of exercise self-efficacy would be less than their post-exercise ability. The results suggested that self-efficacy can potentially operate as a psychological barrier to exercise participation.

Previous research has reported an increase in adolescent (9-17 years of age) self-efficacy following treadmill performance (126, 141). In contrast, the present study observed a decrease in exercise self-efficacy following aerobic exercise participation by young children. One reason the current findings were not consistent with previous reports may be related to subjects' previous aerobic experience. The extent of prior exposure to aerobic exercise may have contributed to their ‘belief in their ability to engage successfully in the PACER’ (30). Previous exercise performance has been noted as one way in which self-efficacy is acquired and serves to promote an ongoing physical activity cycle. This premise was supported in numerous studies with youth where perceived ability to perform physical activity was in part based upon historical performance (51, 70, 83, 103, 126, 130, 141, 152). Previous exercise experience influenced beliefs about future performance attempts. However, subjects in the present investigation did not have previous experience with the PACER shuttle run. Subjects’ pre-exercise self-efficacy perceptions were at least in part based upon the PACER instructional set and demonstration video (111). Therefore, the lower exercise self-efficacy beliefs following actual performance may have represented a more accurate cognitive appraisal related to the task-specific nature of the PACER. Paradoxically, the cyclic premise that historical performance impacts future beliefs, would predict the ‘actual’ exercise self-efficacy rating responses observed presently *may* negatively influence future exercise self-efficacy beliefs. Follow-on investigations will be needed to determine if reported exposure to a given type of aerobic exercise reverses the valence of the self-efficacy mismatch observed presently, thus promoting future participation. As Buckworth and Dishman have noted in their work with both children and adults, self-efficacy is both a ‘determinant and a consequence of physical activity’ (Figure 2.8, p. 39) (30).

Interestingly, Robbins et al. noted that the higher post-activity self-efficacy scores of adolescent subjects were potentially “related to an increasing comfort with the laboratory environment over time” (141). They recommended further study of the effect of factors such as environment upon exercise self-efficacy. In the present investigation, the ‘environment’ in which the PACER was performed was the subjects’ regularly used gymnasium. It is expected that self-efficacy is routinely fostered in such a familiar Physical Education environment. Following the logic of Robbins et al., if the subjects' natural exercise environment contributed to the greater pre-exercise ability beliefs observed presently, then it would also logically follow that the familiar environment should have influenced *both* pre-, and post-exercise self-efficacy equally i.e., a response match. This was not the finding in the present study. As such, it appears that the overprediction of exercise self-efficacy was not influenced by the natural exercise environment.

In summary, the finding that pre-exercise self-efficacy was greater than post-exercise self-efficacy did not support the research hypothesis. It is possible that previous exercise experience contributed to current exercise efficacy expectations (51, 70, 83, 103, 104, 126, 130, 152). In contrast, the 'familiar' environment of the children's school gymnasium likely did not influence efficacy expectations as suggested by previous research (141). The findings suggest that self-efficacy can potentially operate as a psychological barrier to exercise participation.

4.9.1.3 Exercise Enjoyment

Enjoyment scores did not differ between the pre-, and post-exercise measurement periods when total group data were analyzed. These findings indicated a response "match" for the exercise enjoyment variable. Gender specific analysis also indicated a response match between pre-, and post-exercise enjoyment for both female and male children. These findings were not consistent with the hypothesis that pre-exercise enjoyment would be less than post-exercise enjoyment. Therefore, enjoyment was *not* perceived as a psychological barrier associated with the performance of the PACER shuttle run.

The hypothesized pre-to-post-exercise mismatch in enjoyment scores was based upon the research of Robbins et al. (141). These authors noted that enjoyment of physical activity appeared as the inverse of perceived discomfort. However, middle school subjects in the present study anticipated experiencing moderate 'fun' when performing the PACER aerobic activity, and subsequently remained consistent in their actual enjoyment assessment. These results generally supported previous research which indicated that enjoyment 1) "has a strong and singularly consistent relationship with a child's physical activity" (153); 2) was children's primary reason for participating in physical activity (75); and, 3) can be an 'influential variable in children's physical activity interventions' (54, 133).

The enjoyment responses can in part be explained by: 1) Dishman et al. who proposed that enjoyment of exercise *may* be an intrinsic motivational variable mediated by self-efficacy beliefs (54); and, 2) Bandura's Theory which addresses the influence of self-efficacy on affective states (11). In the present investigation, correlation analysis indicated that subjects' anticipation of 'fun' was not associated with their *pre*-exercise ability beliefs. However, post-exercise enjoyment was positively correlated with post-exercise self-efficacy which does support previous research (11, 54). These relations are further discussed in the next section dealing with Hypothesis II.

In summary, the findings of the present investigation indicated that: 1) for the total and female groups, predicted was greater than actual exercise discomfort; while for the male group predicted and actual exercise discomfort were the same; 2) exercise self-efficacy was greater pre-, than post-exercise for both male and female groups; and 3) exercise enjoyment was the same pre-, and post-exercise for both male and female groups. As such pre-participation predictions of exercise discomfort and self-efficacy may potentially operate as psychological barriers to aerobic exercise participation by middle school children. In contrast, when examined within a match-mismatch paradigm, enjoyment may not operate as a psychological barrier in middle school children having characteristics similar to the subjects employed presently.

4.9.2 Interrelations: Exercise Discomfort, Self-Efficacy, Enjoyment

The interrelations between predicted and actual exercise discomfort, pre-, and post-exercise self-efficacy and pre-, and post-exercise enjoyment were also examined in the present investigation. Hypothesis II stated that 1) predicted exercise discomfort would be negatively correlated with pre-exercise self-efficacy and enjoyment and 2) actual exercise discomfort would be negatively correlated with post-exercise self-efficacy and enjoyment. Research Purpose III examined selected relations among the main experimental variables and demographic variables.

4.9.2.1 Exercise Discomfort and Self-Efficacy

No significant correlations between predicted and actual exercise discomfort and pre-, and post-exercise self-efficacy were observed. Thus, the research hypothesis was *not* supported.

A number of previous investigations suggested that socio-cognitive variables such as self-efficacy can influence intensity of perceptual discomfort during physical activity participation (6, 8, 13, 36, 70). Interestingly, when data for the total group were examined, both exercise self-efficacy and exercise discomfort ratings were higher prior to than following exercise participation. Taken collectively, these results suggested that exercise discomfort and exercise self-efficacy beliefs were not interrelated barriers to children's aerobic exercise participation. Further, examination of the gender-specific responses for discomfort indicated that neither the overprediction of exercise discomfort by female children, nor the matched response by male children was influenced by exercise self-efficacy beliefs.

Bandura noted that 'social comparative information figures prominently in self-efficacy appraisals' (11). Subjects in the present investigation may have made a 'social self-comparison' that resulted in a higher efficacy appraisal regardless of anticipated discomfort. In fact, Petosa et al. noted that social outcome expectations predicted both college student and adolescent physical activity participation (129-130). The absence of a relation between exercise discomfort and self-efficacy may also be explained by what Bandura called pre-participation arousal (11). He noted that perceptual threats (e.g. discomfort) could be tempered with learned techniques such as biofeedback. When such techniques were used, heightened self-efficacy also occurred (22, 30). It is not known whether the present subjects had learned techniques that would mediate discomfort perceptions to heighten their self-efficacy beliefs regarding performance of the PACER shuttle run. However, Motl et al. manipulated self-efficacy beliefs of college women with 'bogus' performance feedback to examine muscle pain and exertional perceptions during a cycle test and found: 1) 'higher pre-exercise efficacy scores were moderately associated with lower ratings of both leg muscle pain intensity and overall perceived exertion' during the preliminary low intensity cycle test; however, 2) no significant relation between efficacy and leg muscle pain or efficacy and overall rating of perceived exertion during the moderate intensity cycle exercise test were noted (115). The present findings involving a moderately intense shuttle run are generally consistent with Motl et al. observations for *moderate* intensity cycle ergometry (115).

4.9.2.2 Exercise Discomfort and Enjoyment

No significant correlations between predicted and actual exercise discomfort and pre-, and post-exercise enjoyment were observed. Thus, the research hypothesis was *not* supported.

As noted earlier, this finding was not consistent with a previous report which asserted that 'enjoyment is postulated to reflect a perceptual belief that is the reverse of a perception of exercise discomfort' (141). The overprediction of discomfort by female children, and the matched discomfort response by male children occurred independent of a correlation between predicted discomfort and pre-exercise enjoyment. Similarly, actual discomfort was not correlated with post-exercise enjoyment. Therefore, the match between pre-, and post-exercise enjoyment was independent of either the predicted or actual exercise discomfort responses. It is unlikely that for the children studied, exercise discomfort and enjoyment functioned as interrelated psychological barriers to aerobic activity participation.

The mean discomfort responses of the total group (predicted: 25.97; actual: 19.38) fell within the lower portion of the 0-100 response range. Therefore, the level of predicted and actual exercise discomfort reported by the children studied presently may not have been sufficient to diminish the post-exercise enjoyment response.

Studies with children regarding the relation of enjoyment with other physical activity related factors are limited. However, in one study Prochaska et al. reported that accommodating a child's activity preference encouraged participation enjoyment (133). It may be speculated that subjects who elected to participate in the present investigation may have perceived the PACER as a 'physical activity preference'. As such, preference choice may have taken precedence over a potential interrelation between physical activity discomfort and enjoyment.

Investigations that have examined the interrelation between enjoyment and self-efficacy on children's participation in physical activity are discussed below.

4.9.2.3 Exercise Enjoyment and Self-Efficacy

A significant correlation was noted between post-exercise enjoyment and post-exercise self-efficacy (r = .302; p = .041). This finding was in agreement with previous research that has consistently linked enjoyment with children's 'ability beliefs' (22, 54, 142). Interestingly, significant correlations were not observed between pre-exercise enjoyment and pre-exercise self-efficacy or pre-exercise enjoyment and post-exercise self-efficacy. Results do and do not support the work of Dishman et al. who summarized a number of studies that examined interrelations between exercise self-efficacy and enjoyment in adolescents (53-54). First, these researchers noted that 'an increased self-efficacy mediated an influence on enjoyment of physical activity'. This report was not consistent with findings in the current study as pre-, and post-exercise self-efficacy and enjoyment responses were not correlated. Further, post-exercise self-efficacy ratings decreased in the present study whereas, post-exercise enjoyment responses remained the same. Second, Dishman et al. reported that physical activity enjoyment: 1) 'operated by its influence on an indirect mediated *increase* in self-efficacy'; and, 2) 'did not indirectly mediate an influence on physical activity self-efficacy' (53-54). The positive correlation between post-exercise self-efficacy and post-exercise enjoyment in the current study indicated a potential mediating influence between these two variables which was consistent with the report by Dishman et al. (53-54). However, post-exercise self-efficacy decreased in the current study which was not consistent with the increase observed by Dishman et al. (53-54). It can be speculated that since pre-exercise self-efficacy was greater than post-exercise and pre-, and post-exercise enjoyment were the same: 1) the post-exercise self-efficacy decrease did not negatively mediate an influence on enjoyment; and, 2) although post-exercise self-efficacy decreased, post-exercise enjoyment could potentially be a mediating influence that prevents further decrease in children's self-efficacy beliefs about aerobic exercise. Therefore, the present findings are generally consistent with the Dishman et al. observation that it is 'theoretically plausible' that enjoyment and self-efficacy are mediating variables on physical activity and that interventions designed to increase physical activity should not underestimate their impact (53-54).

In summary, it was expected that exercise discomfort, self-efficacy and enjoyment would be interrelated psychological constructs operating as potential psychological barriers to middle school children's participation in aerobic exercise. This expectation was not supported with the exception of the significant relation observed between post-exercise self-efficacy and post-exercise enjoyment.

4.9.2.4 Exercise Discomfort, Self-Efficacy, Enjoyment: Interrelations and Ideographic Analysis

Significant correlations were noted between predicted and actual exercise discomfort, pre,-and post-exercise self-efficacy and pre,-and post-exercise enjoyment.

The high correlation (r = .701) between predicted and actual exercise discomfort indicated that those subjects who expected more discomfort at the pre-exercise measurement point reported more discomfort at the post-exercise measurement point. Ideographic analyses further highlighted the intrinsic value of the match-mismatch paradigm: 68% of subjects (n = 23) in the present study *overpredicted* exercise discomfort, 24% (n = 8) *underpredicted* exercise discomfort and 8% (n = 3) accurately *predicted* exercise discomfort. The percentage of subjects in this study that overpredicted exercise discomfort was higher than the 20%

reported by Poulton et al. for young adults (132). Interestingly however, current findings were more consistent with previous clinical studies on exercise *pain* that noted a comparatively greater percentage (33%) of 'individuals who generally overpredict pain' (61, 135, 136). The data from pain research may be particularly useful in explaining the overprediction of exercise discomfort observed in the present study. The mean predicted RMH was greater than the actual exercise RMH for the total, female and male groups. Therefore, the overprediction of muscle hurt likely served as the primary factor that influenced the overprediction of exercise discomfort. O'Connor and Cook reported that 'naturally occurring leg muscle pain at peak exercise elicited *greater* total pain response when compared to other noxious stimuli' (122). As noted by Rachman and Lopatka the tendency to overpredict pain may be functional and serve to protect an individual from a potentially aversive situation and subsequent physical damage such as might occur at extremely high exercise intensities (136). The prediction of pain is described as a protective mechanism. Thus, it can be speculated that the overprediction of RMH for subjects in the current study may have been a protective mechanism related to the unknown and potentially 'noxious stimuli' associated with the PACER shuttle run performance.

However, Rachman & Lopatka emphasized that prediction *accuracy* must be learned (136). These researchers noted that it is important for an individual to accurately predict pain to prevent behavior avoidance. For example, the correlation between predicted and actual exercise discomfort for the total group is congruent with potential concerns noted by Poulton et al. (132). These researchers reported that overprediction of discomfort 'may lead to avoidance or lack of exposure to exercise in subsets of the population' (132, 135). Consistent with the Poulton et al. postulate, Philips noted that "an individual in pain will tend to avoid stimulation and involvements and to reduce physical activities" (131). Over time physical activity avoidance by both adults and children can be influenced by 'beliefs and memories' of pain and an 'overall preference for reduced discomfort' (131). Based on the present findings, it is suggested that interventions be developed to help children learn to expect and accept moderate and reasonable levels of muscle hurt in order to promote and not avoid exercise participation. As Janal et al. have stated 'regular exercisers have an increased pain threshold' and that higher pain tolerance facilitated exercise endurance with its subsequent health benefits (31, 80, 122).

A high correlation (r = .720) was found between pre-, and post-exercise self-efficacy. This indicated that subjects who had higher self-efficacy prior to exercise reported higher self-efficacy post-exercise. This finding is in agreement with Bandura's Self-Efficacy Theory (11-13, 156). The theory holds that self-efficacy is the belief in one's ability to enact behavior to produce desired results. This is opposed to the belief that one cannot attain a desired outcome regardless of the amount of effort put forth. As such, the strong positive correlation between pre-, and post-exercise self-efficacy observed presently was consistent with previous research of 'evolving self-efficacy beliefs' associated with exercise behaviors' (70, 104, 106, 126, 141, 150, 152). Subjects reporting higher pre-exercise self-efficacy outcome expectations in turn reported a higher post-exercise self-efficacy, initiating a beneficial cyclic process for future exercise appraisals (*Figure 8, p.35*). The present findings regarding pre-, and post-exercise self-efficacy responses in children suggest a physical activity intervention strategy. Self-efficacy underlies expectations for capability of performing physical activities and exerts a major influence on thoughts that can either help or hinder capabilities for performance. It is logical to design physical activity interventions that promote high ability beliefs (70, 104, 106, 126, 141, 150, 152). In fact, in a longitudinal Physical Education study that noted a decline in physical activity from the fourth to the sixth grades, Prochaska et al. suggested that 'matching students with activity preferences' could improve ability beliefs and enjoyment, increasing physical activity participation over time (133).

Finally, the highest correlation (r = .850) among those calculated presently was noted between pre-, and post-exercise enjoyment. This indicated that subjects with higher ratings of enjoyment prior to exercise reported higher enjoyment post-exercise. This finding was consistent with a previous report indicating that enjoyment is a cognitive variable having a positive association with children's physical activity behavior (54, 75-77, 104, 142). For example, Dishman et al. reported that: 'the effect of enjoyment on physical activity was real and increased enjoyment resulted in increased physical activity' (54). The Florida alliance for successful Physical Education programs for children stated that children participated in sports and physical activity for fun. Exercise enjoyment findings in the current study were in agreement with previous research indicating the positive association of 'fun' with physical activity (47). Based on the present findings, it can be suggested that consideration of children's enjoyment of physical activity should be considered when developing interventional strategies to improve physical activity participation (54).

In summary, consistent with previous research, interrelations and ideographic analysis indicated that exercise discomfort, self-efficacy and enjoyment are psychological constructs that influence the aerobic exercise experience of middle school children.

4.9.3 Discomfort Predictions and Selected Demographics

The present investigation examined differences in subject demographic and performance variables between subjects who under-and-over predicted exercise discomfort.

Results indicated one statistically significant finding: subjects who underpredicted discomfort participated in a greater number of hours per week of recreational activity than those who overpredicted discomfort. Differences between under-and-over predictors were not noted in number of days in which hard exercise was reported or in the number PACER laps completed. Poulton et al. noted that 'overpredictors (of discomfort) reported fewer days on which they engaged in at least 30 minutes of physical activity' (132). Therefore, the present results were in agreement with Poulton et al. observation that 'physical inactivity may partially result from specific physical activity-related cognitions' such as perceived discomfort (132). Overpredictors in the present study reported lower levels of recreational physical activity participation. This is indicative of the 'physical activity avoidance behavior' that has been shown to occur in individuals who overpredict exercise discomfort (132, 135, 136). When cognitions such as 'anticipatory anxiety were rated high regarding an object or event', this appraisal process led to avoidance behavior (132, 135, 136). Poulton et al. applied this concept to their physical activity data and noted that individuals who reported high anxiety associated with anticipated exercise were "more likely to avoid physical exercise and miss the opportunity to disconfirm erroneous expectations" (132). In fact, they reported that young adults who were overpredictors generally had 'lower levels of physical activity, and worse scores on all physical health measures' (132).

Interestingly, the time spent each day in physical activity and sport participation suggested that as a group subjects in the present study met the Health Education Authority guidelines for physical activity participation (19). These guidelines state that "For all young people, participating in at least 30 minutes of PA (physical activity) per day should be seen as a minimum: One hour of moderate intensity activity per day represents a more favorable level"

(19). Eighty-five per cent of the total group reported at least 3 days per week of vigorous exercise and 76% reported at least three days per week of light exercise. Average time spent in leisure activity for the total group was 9.5 hours per week. For the total group, average time spent watching television (2-3 hours per day) was slightly less than the reported national mean of 3 hours per day (71). A comparison of the time spent in physical activity with time spent watching television suggested a physically active subject sample.

Further, the mean maximal oxygen uptake predicted from the number of PACER laps completed indicated that the aerobic fitness level of the total subject sample fell within criterion-referenced national standards for aerobic fitness (18).

Finally, the mean BMI for the total group indicated a sample of children who were at lower risk for health problems associated with obesity (4, 34). Additionally, the percentage of overweight subjects (11.5%) was below that reported by NHANES 1999-2002 where approximately 16% of children and adolescents ages 6 to 19 years old were estimated to be overweight (34).

Therefore, the physical activity, PACER Laps/estimated maximal oxygen uptake and BMI data provided a broad parameter for assessment of subjects' health-related fitness. The subjects in the present study were within acceptable criterion referenced physical fitness standards (19, 34). Since enrollment in the present study was voluntary, there may have been a subject selection bias that encouraged participation by a physically active subset of the larger population of Falk Middle School children. In addition, this study may have attracted a selected sample of physically active Falk Middle School students who were of normal body weight based on NHANES standards.

4.9.4 Exercise Self-Efficacy, Enjoyment, PACER Laps

Positive correlations were found between PACER laps and pre- (r = .582; p< 0.01) and post-exercise (r = .703; p< 0.01) self-efficacy. This finding is consistent with previous research. First, the PACER Shuttle Run has frequently been used as a field test for aerobic fitness in youth (18, 46, 97-98, 111, 178). Higher levels of fitness have been associated with higher levels of exercise self-efficacy (18, 22, 86, 111). Since subjects in the present study were within acceptable criterion referenced physical fitness standards, it can be speculated that the correlation observed between self-efficacy and completed PACER laps was at least in part influenced by the subjects' aerobic fitness. This speculation is consistent with Buckworth and Dishman's observation that for both adults and children 'physiological variables can play a critical role in behavior and interact significantly with psychosocial constructs' (30).

Second, Buckworth and Dishman also noted that the most consistently reported cognitive variable to influence the 'choice of activity, amount of effort expended, and the degree of persistence' was exercise self-efficacy (30). It may be speculated that the comparatively *higher* pre-exercise self-efficacy rating exerted a positive influence on PACER shuttle run performance. Exercise self-efficacy was postulated to be dependent upon the specific task and situation (13, 30). Although the subjects in this study did not have experience in performing the PACER shuttle run, their higher pre-exercise self-efficacy may have been influenced by previous experiences (11, 13, 30) with aerobic exercise as reported in their physical activity history (Appendix J). Thus, although exercise self-efficacy evidenced a response mismatch in the current study, it did *not* operate as a barrier for subjects performing the PACER shuttle run. This finding is generally consistent with previous studies describing exercise self-efficacy as “the strongest and most consistent predictor of exercise behavior’ with children (23, 156, 158).

Correlations observed between pre- (r = .118) and post- (r = .125) exercise enjoyment and PACER laps were not significant. The lack of a relation between exercise enjoyment and PACER performance was somewhat unexpected. First, given the significant correlation between pre-, and post-exercise enjoyment ratings, it would logically follow that a positive correlation would be noted between ‘having fun’ and completed PACER laps. Second, several studies that have observed a positive correlation between aerobic fitness and exercise self-efficacy have also shown positive correlations between fitness and physical activity enjoyment (18, 22, 86, 111). Thus, a positive correlation would be expected between exercise enjoyment and number of PACER laps completed given the positive correlation noted between post-exercise self-efficacy and enjoyment. Finally, previous research involving 6078 11-19 year old children and adolescents indicated that the perception of physical activity as fun was moderately related (r = 0.41) to physical activity performance (44). Dishman et al. observed that enjoyment was an ‘understudied mediator’ for children’s activity requiring further research (54). The present findings are consistent with this conclusion.

4.9.5 Physical Activity Implications: Barriers and Interventions

A consistent public health message is the need to better understand how psychological barriers influence youth’s physical activity participation (22, 28-29, 47, 125, 127, 156, 164). Employing a match-mismatch experimental paradigm to explore exercise discomfort, self-efficacy and enjoyment suggested that these psychological constructs may influence children’s beliefs about an aerobic physical activity. These findings have implications for physical activity interventions involving aerobic exercise for middle school children. Previous research has noted that cognitive appraisal processes may partially explain the level of physical activity participation. Therefore, children should be educated regarding pre-exercise perceptions associated with the aerobic physical activity to be performed. (132, 135-136).

First, educating children regarding realistic predictions of exercise discomfort would provide them with a cognitive reference upon which to accurately assess their actual aerobic exercise discomfort. In this way subsequent exercise participation is promoted rather than avoided (131). Poulton et al. strongly recommended such educational interventions in order to deter the negative health effects associated with discomfort overprediction and subsequent exercise avoidance (132). Employing the clinical pain research of Koyama et al. provides a strategy to alter exaggerated exercise discomfort predictions with middle school children (89). Koyama et al. noted that the higher the expectation of pain, the higher the intensity of pain actually experienced (89). Correlations involving exercise discomfort in the present study were consistent with Koyama et al. observations, i.e., subjects who predicted more discomfort experienced more discomfort and subjects who predicted less discomfort experienced less discomfort. Koyama et al. reported that individuals reconstructing a positive mental representation of an anticipated pain event during the expectation period ‘produced a robust decrease in pain following pain expectation’ (89). Therefore, helping children create a positive mental image of aerobic exercise prior to actually doing the exercise would logically lead to a decrease in actual discomfort perception. For example, children could be shown a video of other children having fun while running the PACER, developing a pre-participation mental representation (111). Similarly, to decrease perception of pain, Von Baeyer et al. recommended providing ‘detailed and credible information which enables children to self-create a familiarity that increases the child's sense of control' (174). In other words, accurate information can be used to 'manipulate pain expectation' to create a new mental representation (89) as Motl et al. did with young college women (115). Information used to manipulate 'expectation of pain powerfully reduces both the subjective experience and the actual activation of pain-related brain areas' (89). Therefore, children can learn techniques to create a positive representation of aerobic exercise which promotes attraction to the physical activity with its subsequent health benefits.

McAuley and Mihalko developed a strategy to address self-efficacy beliefs about abilities and overcoming perceived barriers which can apply to intervention techniques for aerobic exercise with children (105). They recommended allowing a pre-exercise practice period prior to exercise participation. An assessment of ability beliefs to determine if perceived participation barriers were or were not overcome occurs following the pre-exercise practice to correct any misrepresentations. Since higher levels of exercise self-efficacy have been associated with higher levels of fitness (18, 22, 86, 111), implementing a pre-exercise practice may promote physical activity participation of the type that improves physical fitness. Further, self-efficacy is a cyclic learning process in which children's positive beliefs about aerobic exercise ability can create future positive exercise beliefs. Creating such a positive cycle of physical ability beliefs could contribute to a reversal of the physical inactivity trends and associated health risks reported for American children (1, 23, 105, 156, 158, 162, 178).

Finally, the responses regarding exercise enjoyment in the current study were consistent with the limited research indicating that enjoyment is a critical, but 'understudied' variable in determining children's physical activity participation (47, 54, 75). Previous research suggested three ways to incorporate enjoyment in physical activity programs: 1) match a physical activity with a child's preference as much as possible (133); 2) increase aerobic fitness which has been tied to greater enjoyment of physical activity (86, 141); and, 3) encourage physical activity self-efficacy beliefs which are tied to physical activity enjoyment (53-54) .

Brawley et al. summarized that 'efforts must be made to understand the psychology of perceived barriers if we expect to make advances toward facilitating greater involvement in physical activity' (28). The current study addresses such research initiatives. Further, Dishman et al. proposed that physical activity interventions for youth have not been effective because 'social-cognitive correlates which are putative on volitional choice have not been targeted' (51-52). The present study suggests 'targeting' psychological constructs such as discomfort, self-efficacy and enjoyment in interventions that address physical activity barriers. Identifying and eliminating these potential psychological barriers to physical activity participation is a critical interventional step to reversing the inactivity crisis in our nation's youth (1, 16, 35, 41, 50, 52, 101, 171).

5.0 SUMMARY AND RECOMMENDATIONS

The current study employed a match-mismatch paradigm to examine exercise discomfort, self-efficacy and enjoyment as psychological constructs that operate in a complex cognitive appraisal process during aerobic exercise (PACER) in middle school children (Figure 1, Page 9). A sample of thirty four Falk Laboratory School female and male middle school children aged 11 to 14 years participated in the investigation. Descriptive information regarding BMI, physical activity level, sport participation history and estimated maximal oxygen uptake indicated that subjects met acceptable criterion referenced health and physical fitness standards (19, 34). In summary, findings indicated:

Hypothesis I: 1) Exercise discomfort scores for the *total and female groups* were greater for the predicted than actual measurement period. This finding was consistent with the research hypothesis. However, predicted and actual exercise discomfort scores for the *male group* were the same and did not support the hypothesis. 2) Pre-exercise self-efficacy was greater than post-exercise self-efficacy for both male and female groups. This finding did not support the research hypothesis that subjects' pre-exercise rating of exercise self-efficacy would be less than their post-exercise rating. 3) Exercise enjoyment scores were the same pre-, and post-exercise for both male and female groups. This finding was not consistent with the research hypothesis that pre-exercise enjoyment would be less than post-exercise enjoyment.

Hypothesis II: It was expected that middle school children's exercise discomfort, self-efficacy and enjoyment would be interrelated psychological constructs during aerobic exercise participation. With one exception, findings did not support this hypothesis. The exception was that post-exercise self-efficacy was significantly correlated with post-exercise enjoyment for the total group data.

Research Purpose III: Interrelations and ideographic analysis indicated that exercise discomfort, self-efficacy and enjoyment are psychological constructs that may influence the aerobic exercise experience of middle school children. Differences in demographic and performance variables between subjects who under-and-overpredicted exercise discomfort indicated one significant finding: subjects who underpredicted discomfort participated in a greater number of hours per week of recreational activity than those who overpredicted discomfort. A significant relation was noted between the number of PACER laps completed and pre-, and post-exercise self-efficacy, but not between PACER laps and enjoyment.

In conclusion, the present investigation focused on selected underlying psychological constructs that may contribute to the physical activity behavior of youth. This investigation was intended to provide empirical reference points that addressed the 'call to action' to reverse the physical inactivity trends and associated loss of health benefits observed in American children (161). Employing a match-mismatch experimental paradigm suggested that exercise discomfort, self-efficacy and enjoyment were psychological constructs that may influence children's beliefs about an aerobic physical activity. Specifically, the sample of middle school children in this study: a) predicted greater aerobic exercise discomfort than actually experienced; b) reported greater pre-than-post aerobic exercise self-efficacy ratings; and c) reported the same pre-and-post aerobic exercise enjoyment. These findings indicated that understanding psychological processes underlying the aerobic physical activity participation of children are critical to ensuring an accurate 'applied psychology knowledge base' for successful long-term interventional strategies (85). It is possible that one or more of these constructs plays an important role in the initiation and maintenance of aerobic exercise by middle school children. Such findings can in turn inform physical activity interventions and/or innovative health-fitness components of Physical Education curricula intended to promote cardiovascular health and fitness through regular participation in aerobic physical activity.

Several limitations of the present study should be noted: 1) the use of a convenience sample may have attracted middle school students who were favorably predisposed to exercise participation; 2) aerobic fitness level was estimated, not directly determined; 3) aerobic physical activity status was obtained from the physical activity and sport participation self-report, PACER Laps/estimated maximal oxygen uptake and BMI data; 4) the use of a less controlled field test setting as contrasted to a controlled laboratory setting; 5) methodological limitations intrinsic to the match-mismatch paradigm; and 6) Institutional Review Board requirement to instruct subjects that they could stop at any time during the PACER test may have resulted in an inadequate exercise forcing function.

5.1 RECOMMENDATIONS

It is recommended that future research:

I. Employ a match-mismatch paradigm to study exercise discomfort, self-efficacy and enjoyment responses for:

A. Different exercise modes, i.e. weight bearing and non-weight bearing aerobic; anaerobic/sprint; resistance exercise in both field and laboratory settings;

B. Different subject demographics: female and male adolescents 14 to 18 years old preferably selected using random sampling methods; individuals who fall below and above criterion referenced health fitness standards using objective laboratory measurement; students in both private and public schools.

C. Different post-exercise data collection time frames to explore multiple match-mismatch ratings.

D. Examination of factors that potentially influence exercise discomfort, self-efficacy and enjoyment such as social comparison, use of biofeedback techniques, motivation for physical activity.

II. Examine the effect of various intervention strategies on the three psychological constructs and associated changes in physical activity participation:

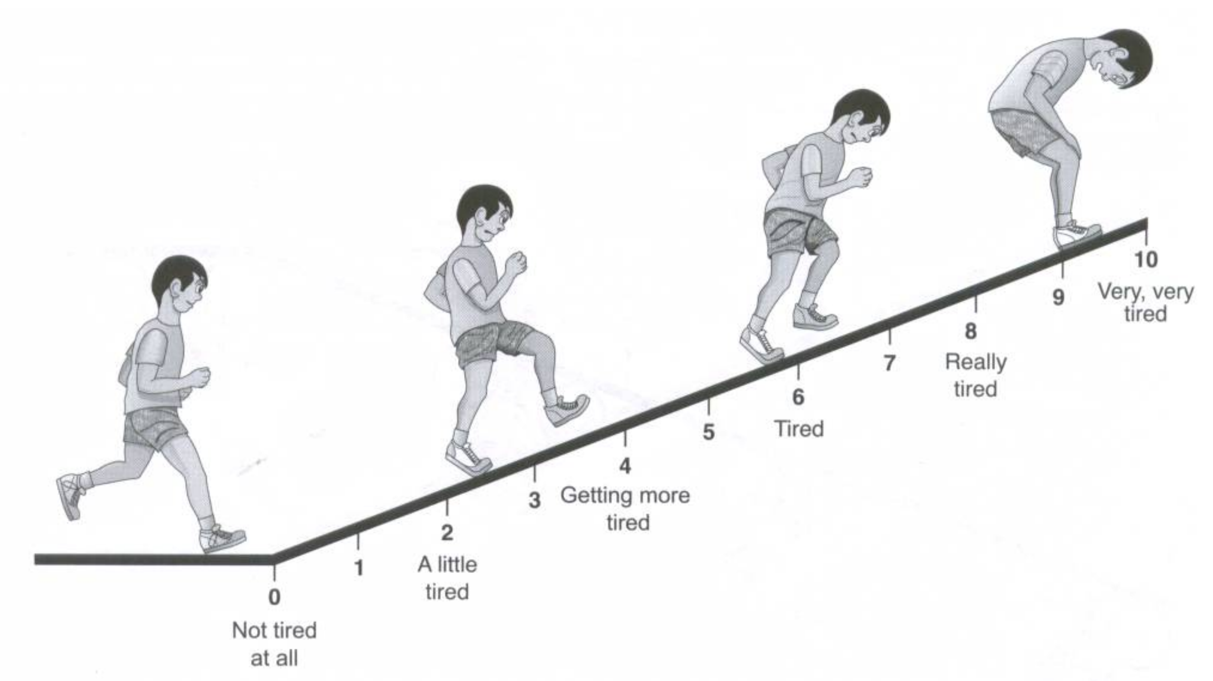
A. Use the Exercise Discomfort Index to provide children with a cognitive reference upon which to accurately assess their actual aerobic exercise discomfort and to monitor changes in exercise discomfort, self-efficacy and enjoyment participation;

B. Incorporate novel physical activity descriptive information such as video technology to diminish negative physical activity perceptions;

C. Examine self-efficacy mismatch reports to determine if repeated exposure to a given type of aerobic exercise (e.g., *FITNESS*GRAM activities) reverses the valence of the observed mismatch thereby promoting future participation.

APPENDIX A

CHILDREN'S OMNI SCALE OF PERCEIVED EXERTION: WALK/RUN (144)



ID: ____

RPE—Overall: __________________________

A.1.1 APPENDIX A.1

INSTRUCTIONS FOR USING THE CHILDREN'S OMNI SCALE OF PERCEIVED EXERTION (144)

Definition of Exertion:

I am defining exertion as how tired your body feels/felt during the PACER shuttle run.

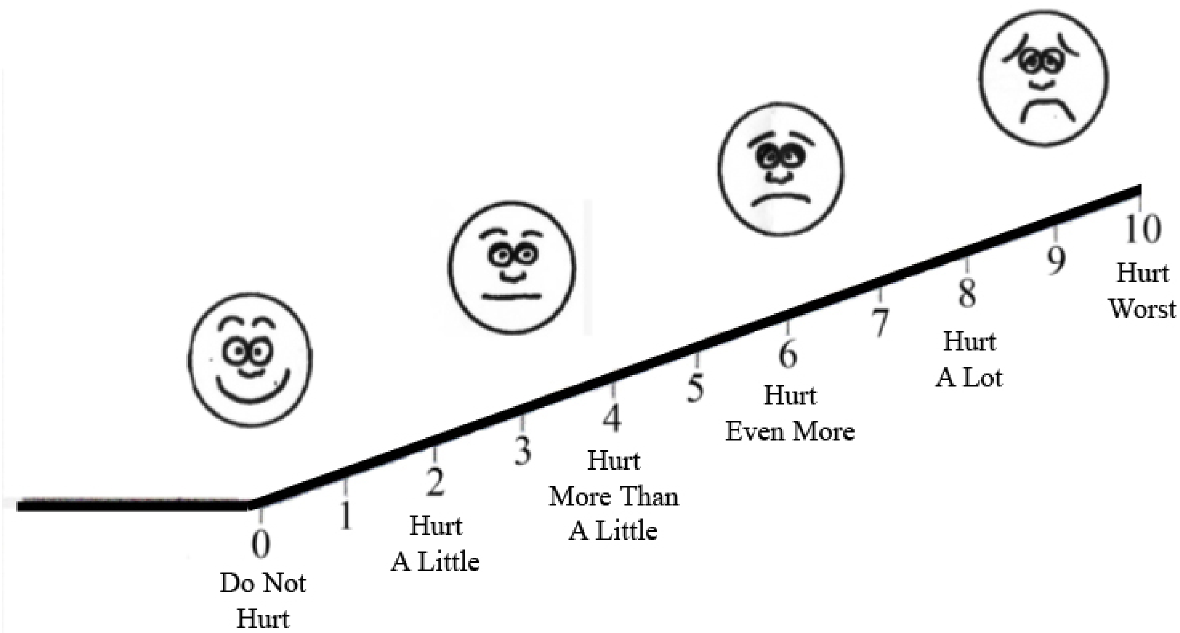
Instruction:

Predicted RPE Instructions: I would like you to use the picture you have before you to describe how your body will feel during the PACER you just watched on video. Please use the numbers on this scale to tell me *how you think you will feel when you are running.* Please look at the person at the bottom of the hill who is just starting to run (*point to the left-hand picture*). If you think you will feel like this person looks when you run you will *not be tired at all*. You should select the number 0. Now look at the person who is barely able to run to the top of the hill (*point to the right-hand picture*). If you think you will feel like this person looks when you are running, you will be *very, very tired*. You should select the number 10. If you feel like you will be somewhere between *not tired at all* (0) and *very, very tired* (10), then give a number between 0 and 10. I will ask you to pick a number to tell how your overall body will feel. There is no right or wrong number. Use both the pictures and the words to help you pick a number. Use *any* of the numbers to tell how your *overall body will feel* running the PACER. Do you have any questions? Please write the number in the blank space on your form below your name that tells how tired you think *your overall body will feel*.

Actual RPE Instructions: Please look at the picture of the person running up a hill. Use the numbers on this picture to tell me *how tired you actually felt when you ran.* Please look at the person at the bottom of the hill who is just starting to run. If you felt like this person looks when you ran you were *not tired at all*. You should select the number 0. Now look at the person who is barely able to run to the top of the hill. If you think you felt like this person looks when you ran, you were *very, very tired*. You should select the number 10. If you felt like you were somewhere between *not tired at all* (0) and *very, very tired* (10), then give a number between 0 and 10. I will ask you to pick a number to tell how your overall body *felt*. There is no right or wrong number. Use both the pictures and the words to help you pick a number. Use *any* of the numbers to tell how your *overall body felt* running the PACER. Do you have any questions? Please select the number that tells how tired your *overall body felt* when running the PACER.

APPENDIX B

CHILDREN'S OMNI SCALE OF PERCEIVED HURT (145)



ID: ____

RMH—Legs: __________________

B.1.1 APPENDIX B.1

INSTRUCTIONS FOR USING THE
CHILDREN'S OMNI SCALE OF PERCEIVED HURT (145)

Definition of Muscle Hurt:

I am defining muscle hurt as the amount or intensity of hurt that you may feel/did feel in your leg muscles during the PACER exercise.

Instructions:

Predicted RMH Instruction: I would like you to use the picture you have before you to describe how much you think your leg muscles might hurt during the PACER shuttle run. As we talked earlier, every minute, following the music and beeps, the run is set to go faster and be harder. Imagine that you are the smiling face on the left side of the picture who is just starting the run and whose leg muscles do not hurt at all. You would select a 0 on the picture. Now imagine that you are the un-smiling face on the right side of the picture who is barely able to run and whose muscles hurt the worst. You would select a 10 on the picture. If your leg muscles feel somewhere between Do Not Hurt (0) and Hurt the Worst (10), then select a number between 0 and 10. I will ask you to give a number that tells how you believe your leg muscles might hurt while running the PACER. Remember, there is no right or wrong number. Use both the pictures and the words to help you select a number. Use *any* of the numbers to tell how you think your *leg muscles might hurt* when running. Do you have any questions? You have a picture of faces before you. Please place the number in the space provided on the form that best predicts how your *leg muscles might hurt* when running the PACER.

Actual RMH Instruction: Please use the picture before you to describe how much your leg muscles did hurt during the PACER shuttle run. Imagine that you are the smiling face on the left side of the picture and whose leg muscles did not hurt. If your leg muscles did not hurt, select the number 0 on the picture. Now imagine that you are the un-smiling face on the right side of the picture whose muscles hurt the worst. If your leg muscles hurt the worst, select the number 10 on the picture. If your leg muscles felt somewhere between Do Not Hurt (0) and Hurt the Worst (10), then say a number between 0 and 10. I will ask you to give a number that tells *how your leg muscles did hurt* while running the PACER. Remember, there is no right or wrong number. Do you have any questions? Use both the pictures and the words to help you select a number. Use *any* of the numbers to tell how your *leg muscles did hurt* when running the PACER.

APPENDIX C

EXERCISE FOR SELF-EFFICACY SCALE: RUNNING (150)

EXERCISE FOR SELF-EFFICACY SCALE: RUNNING

ID:________________________________ DATE:___________________________

Please circle the number below that best describes how confident you are that you can successfully run. For example, if you are very confident that you can run for 4minutes (32 PACER laps) you would circle the number 5. If you are not confident you could run for the 4minutes (32 PACER laps), you would circle the number 1. If you feel somewhere between not confident and very confident, you would circle the number 2 OR 3 OR 4.

I BELIEVE THAT I CAN RUN FOR:

	Not At All Confident		Fairly Confident		Very Confident
1 minute (9 PACER laps) without stopping	1	2	3	4	5
2 minutes (15 PACER laps) without stopping	1	2	3	4	5
3 minutes (23 PACER laps) without stopping	1	2	3	4	5
4 minutes (32 PACER laps) without stopping	1	2	3	4	5
5 minutes (41 PACER laps) without stopping	1	2	3	4	5
6 minutes (51 PACER laps) without stopping	1	2	3	4	5
7 minutes (61 PACER laps) without stopping	1	2	3	4	5
8 minutes (72 PACER laps) without stopping	1	2	3	4	5
9 minutes (83 PACER laps) without stopping	1	2	3	4	5
10 minutes (94 PACER laps) without stopping	1	2	3	4	5
More than 10 minutes without stopping	1	2	3	4	5

APPENDIX D

PHYSICAL ACTIVITY ENJOYMENT SCALE (PACES) (54, 84, 116)

PHYSICAL ACTIVITY ENJOYMENT SCALE (PACES)

ID: ______________________ **Date**____________

Using the 1(disagree a lot)—5(agree a lot) scale below, please circle the number that best describes, your response to, "When I *RUN* I….."

	DISAGREE A LOT…………….				AGREE A LOT
	1	2	3	4	5
1. I enjoy it	1	2	3	4	5
2. I feel bored	1	2	3	4	5
3. I dislike it	1	2	3	4	5
4. I find it pleasurable	1	2	3	4	5
5. It's no fun at all	1	2	3	4	5
6. It gives me energy	1	2	3	4	5
7. It makes me depressed	1	2	3	4	5
8. It's very pleasant	1	2	3	4	5
9. My body feels good	1	2	3	4	5
10. I get something out of it	1	2	3	4	5
11. It's very exciting	1	2	3	4	5
12. It frustrates me	1	2	3	4	5
13. It's not at all interesting	1	2	3	4	5
14. It gives me a strong feeling of success	1	2	3	4	5
15. It feels good	1	2	3	4	5
16. I feel as though I would rather be doing something else	1	2	3	4	5

APPENDIX E

INFORMED CONSENT

FALK SCHOOL
University of Pittsburgh
Allequippa Street
Pittsburgh, PA 15261
Admissions Office Phone: 412-624-8024 Fax: 412-624-1303

RESEARCH ACTIVITIES AT FALK SCHOOL

Falk School's primary purpose is to provide excellent educational experiences for its children. Its role as a campus laboratory school and its location at the University of Pittsburgh makes educational excellence and uniqueness possible. The relationship between the laboratory school and the University brings with it mutual responsibilities. A review of the goals of Falk School and the School of Education suggests that the priorities of the laboratory school that contribute most significantly to the mission of the larger institution are the following:

1. Providing high quality educational opportunities for children
2. Encouraging educational research
3. Developing new educational techniques
4. Disseminating information
5. Providing first-hand teacher education experiences

In order to meet the obligation for Item 2, encouraging educational research, the school has established the following policies.

POLICIES GOVERNING EDUCATIONAL RESEARCH CONDUCTED AT FALK SCHOOL

- **All applicants for enrollment at Falk School are informed of the fact that the school is a campus laboratory school where children participate as subjects in research.**
- **All requests for subjects are reviewed by the Falk School Research Review Committee.**
- **When the Falk School Research Review Committee determines that individual parent permission is needed for a child's participation in a study, the researcher is responsible for obtaining that permission.**
- **Research projects conducted by the school as part of its ongoing operation are reviewed by Falk School Research Review Committee.**

GUIDELINES FOR ADMINISTERING THE POLICY GOVERNING EDUCATIONAL RESEARCH CONDUCTED AT FALK SCHOOL

1. All applicants for enrollment at Falk School are informed of the fact that the school is a campus laboratory school where children participate as subjects in experimental research.

   A copy of these policies and guidelines are included in the packet of admissions materials that are given to parents of prospective students. Parents are asked to sign a Parent Consent form indicating that they have read the statement and are prepared to cooperate with the school within the established policies and guidelines.

   For our purposes, informed consent means that the subjects, or their legal representatives, volutarily agree to participate, after having been informed, in lay terms, of the purposes, procedures, and possible risks or benefits of the research. For children, legal representatives are parents or those designated to act in loco parentis.

PARENT CONSENT FORM

SUBJECT: Participation of children in educational research studies

After reading the attached "Policies and Guidelines for Participation in Educational Research Studies," please sign this form and return it to Falk School. The form will be placed in your child's record folder in the school office. Thank you for your continued cooperation in helping Falk School to become one of the finest laboratory schools in the country.

Wendell R. McConnaha
Director

I have read the statement of Policies and Guidelines for Participation in Educational Research Studies and I give my consent to have my child participate in educational research according to the "Policies and Guidelines."

Signature ____

2. All requests for subjects are reviewed by the Falk School Research Review Committee.

Falk School seeks to meet its obligation to the field of education, the research community, and society at large by contributing to the generation of new knowledge. This obligation, however, is secondary to the school's concern for the rights and safety of children who are in attendance. All requests to conduct research at Falk School or involve Falk School children as subjects for research are reviewed by a research review committee. The committee is composed of the Director, and Falk School faculty. The committee serves to protect all human subjects who are involved in school-related research and to satisfy the requirements for informed consent.

Research requests fall into broad categories. The types of educational research activities conducted at Falk School fall into an "exempt" category. A complete description of concept of exempt research and an identification of exempt research activities is explained in the following section.

EXEMPT RESEARCH REVIEW AT 46.101(b) of the Code of Federal Regulations, a number of categories of research are exempted from federal regulatory requirements. The Psychosocial IRB of the University requires that exempt research be certified as such by an official independent of the investigator. If a department of another division of the University has designated an official to serve this function for its research, then this official should indicate his/her certification that a project is exempt through a letter to the IRB Chair, which the investigator can submit with his /her other material. Otherwise, the Psychosocial IRB will certify exemptions itself. The Chair of the Psychosocial IRB retains the prerogative to review decisions of other officials regarding exemptions, but in such cases he/she will notify the investigator of any problems within ten working days of receipt of the submitted materials.

CFR 46.101(b) states as follows:

"Research activities in which the only involvement of human subjects will be in one or more of the following categories are exempt from these regulations unless the research is covered by other subparts of this part.

(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as: (i) research on regular and special education instructional strategies, or research on regular and special education instructional strategies, or (ii) research on the effectiveness of, or the comparison among instructional techniques, curricula, or classroom management methods.

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), if information taken from these sources is recorded in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

(3) Research involving survey or interview procedures, except where all of the following conditions exist: (i) responses are recorded in such a manner that the human subjects can be identified, directly or through identifiers linked to the subjects, (ii) the subject's responses, if they became known outside the research, could reasonably place the subject at risk of criminal or civil liability or be damaging to the subject's financial standing or employability, and (iii) the research deals with sensitive aspects of the subject's own behavior, such as illegal conduct, drug use, sexual behavior, or use of alcohol. All research involving survey or interview procedures is exempt, without exemption, when the respondents are elected or appointed public officials or candidates for public office.

(4) Research involving the observation (including observation by participants) of public behavior, except where all of the following conditions exist: (i) observations are recorded in such a manner that the human subjects can be identified, directly or through identifiers linked to the subjects, (ii) the observation recorded about the individual, if they became known outside the research, could reasonably place the subject at risk of criminal or civil liability or be damaging to the subject's financial standing or employability, and (iii) the research deals with sensitive aspects of the subject's own behavior, such as illegal conduct, drug use, sexual behavior, or use of alcohol.

(5) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects."

The Falk School research review committee imposes different kinds of responsibilities on the investigator depending upon the nature of the request. Requests to conduct research at Falk School include:

a. **Requests to come to the school and observe classroom processes, teacher behavior or children's interactions.** These requests require no alteration nor interruption of classroom procedures. Investigators are permitted to make their observations and individual parent consent is not solicited. Your signature on a general consent form is considered to satisfy the requirements for informed consent. For example, a researcher might be interested in the intervention strategies experienced teachers employ to resolve conflicts between students. The researcher would be permitted to sit in the classroom and record exactly what the teacher did when conflict situations between pupils arose.

b. **Requests that include instructional interventions that the school thinks would be beneficial to the subject.** These submissions suggest strategies or content that amplify or enrich what the school is already trying to do. For example, if a researcher has formally identified a technique for teaching a concept in math that a number of our children are having difficulty understanding, we help the investigator to identify those children and permit the study to proceed. Your signature on this general consent form is considered sufficient to satisfy the requirement of informed consent and individual parent consent is not solicited.

c. **Requests to conduct controlled experiments that require an experimental group and a control group.** Studies of this sort may compare instructional approaches, curricular content or other experimental variables. Because direct intervention is normally required for the experimental group and the omission of that intervention is normally required for the control group, the research review committee requires the researcher to obtain individual parent permission for participation of their child in studies of this type.

d. **Requests to solicit from children information that is associated with their social, emotional or personal reactions or circumstances.** Non-cognitive data is needed in educational research.

Periodically we receive requests from researchers to use our children as the normal group against which they can measure extreme behavior. The research review committee requires the investigator to obtain individual parent permission to have their child included in the studies of this type.

e. **Requests that fall outside of the above categories** are unusual and the research review committee requires the researcher to obtain individual parent permission to have their child participate in these studies.

When the Falk School Research Review Committee determines that individual parent permission is needed for a child's participation in a study, the researcher is responsible for obtaining that permission.

Researchers in the field of education and in other social sciences seek to meet their obligations to their fields of study, the research community, and to society at large by contributing to the generation of new knowledge. When investigators conduct their research at Falk School, it is imperative that they understand that those obligations are secondary to the school's concern for the rights and safety of all human subjects who are involved in research. All researchers who are granted permission to work at Falk School or with Falk School children have the following obligations:

a. **Liability.** Irrespective of how consent is obtained, and whether or not subjects are placed at risk no exculpatory language may be included through which the subject is made to waive any of his/her legal rights, including any release of the researcher from liability or negligence.

b. **Risk.** On rare occasions and in a very small number of studies, the question of physical, emotional, or educational risk presents itself. No circumstance would enable the school to permit research to be conducted that places human subjects at risk. Researchers must be fully responsible for making known to the school and to each subject any and all of the attendant discomforts associated with a study. The investigator is also required to make clear why the discomfort is essential to the study and why the information cannot be obtained in any other way.

c. **Privacy.** Data obtained directly or indirectly about Falk School personnel and children is entirely confidential. Research reports are to be written in such form that anonymity is guaranteed. Individual permission to make public information about individual participants must be obtained from both the school and the participant.

d. **Deception.** These are occasions when a full disclosure of the research purpose and/or procedures will invalidate the study. Included in this type of research are studies that require deception. In cases of this kind, the entire burden of responsibility is upon the researcher. The investigator is required to make clear why the deception is essential to the study and why the information cannot be obtained in any other way. Procedures for debriefing deceived subjects are required, and with children, the deceptive strategy should be turned into some instructional advantage. The overall effect of deception need not be negative and it is the responsibility of the researcher to provide adequate debriefing procedures. When deception is essential to the study, consent from individual parents must be required to make contacts in person or by telephone.

e. **Informed Consent.** Although disclosure of every detail of a research study may be neither useful nor necessary, there are basic elements of information that are required for effective informed consent. The following elements of informed consent are required of investigators who have received permission to conduct research at Falk School.

1. A fair explanation of the procedures to be followed and their purposes, including identification of any procedures which are experimental.
2. A description of any attendant discomforts and risks reasonably to be expected, if any.
3. A description of any benefits reasonable to be expected either for the subject or for society.
4. An offer to answer any inquires concerning the study.

5. An instruction that the individual is free to withdraw his or her consent and to discontinue participation in a project or activity at any time without prejudice to the subject.
6. An instruction that the individual is free to withhold his or her initial consent and not participate in a project or activity without prejudice to the subject.

Research projects conducted by the school as part of its ongoing operation are reviewed by the Falk School Research Review Committee.

Ongoing school sponsored research projects may continue for long periods of time and may have effects upon the school program. Projects of such scope are reviewed by the Research Review Committee because of their possible impact on the school program.

Human learning is the focus of the research and development activities that are carried out in Falk School. The main objective of the policy and procedures set forth in this document is to ensure protection of the rights and well-being of all human participants, in accordance with "University of Pittsburgh Guidelines to the Use of Human Subjects in Psychosocial Research."

Wendell R. McConnaha
Director, Falk Laboratory School

FALK SCHOOL
University of Pittsburgh
Allequippa Street
Pittsburgh, PA 15261
Admissions Office Phone: 412-624-8024 Fax: 412-624-1303

PARENT CONSENT FORM

Subject: *Participation of Children in Educational Research Studies*

After reading the attached ***Policies and Guidelines for Participation in Education Research Studies***, please sign this form and return it to Falk School. The form will be placed in your child's record folder in the school office. Thank you for your continued cooperation in helping Falk School to become one of the finest laboratory schools in the country.

Sincerely,

Wendell R. McConnaha
Director, Falk Laboratory School

I have read the statement of ***Policies and Guidelines for Participation in Educational Research Studies*** and I give my consent to have ________________________, my child, participate in educational research according to the ***Policies and Guidelines***.

____
Parent Signature

____
Date

E.1.1 APPENDIX E.1

LETTER TO PARENT(S)/ GUARDIAN(S)

FALK SCHOOL
University of Pittsburgh
Allequippa Street
Pittsburgh, PA 15261
Admissions Office Phone: 412-624-8024 Fax: 412-624-1303

January 2007

Dear Parents:

Joining us from the University of Pittsburgh, School of Education is Irene Kane, a PhD candidate in the Department of Health and Physical Activity. Ms. Kane, a certified health fitness instructor and licensed registered nurse, is interested in studying the promotion of physical activity participation in children aged 10-14 years old. Her study titled "Predicted and Actual Exercise Discomfort, Self-Efficacy, and Enjoyment in Middle School Children: A Match-Mismatch Paradigm" has been approved by the Falk School Research Review Committee and is funded a by a School of Education Research Grant. There are no costs to participating in this study. The study will be conducted during your son or daughter's health/physical education class time under the direction of Ms. Laura Hunt and 80 participants will be enrolled. Ms. Kane has prepared the information below and is available to answer any questions. Please feel free to discuss the following information with your daughter or son.

- **What is the specific purpose of this study?**

Specifically, the purpose of Ms. Kane's research is to **examine how discomfort, self-efficacy and enjoyment can act as potential barriers to children's physical activity participation**. **Discomfort is defined as how tired a child feels and how their leg muscles feel during exercise. Self-efficacy is the child's belief in her/his ability to do an exercise. Enjoyment is how much fun she/he has doing an exercise.** The **exercise that will be performed is called the PACER** (Progressive Aerobic Cardiovascular Endurance Run) **shuttle run**. The PACER, described as "fun" by children, is set to music and requires running back and forth in a marked lane in the gymnasium. **Each participating child will be asked to rate their discomfort, self-efficacy and enjoyment before and after the PACER.** Height, weight, and physical activity habits will also be recorded.

- **What is the study procedure?**

The study requires two Physical Education classes (approximately 80 minutes). Ms. Kane will be coordinating class time with Ms. Hunt to occur during the fall/winter session. In the first class Ms. Kane will explain the PACER shuttle run and the forms to be completed at an orientation. Your daughter or son will:

1) Listen to verbal PACER instructions and watch a PACER video.

2) Rate her/his predicted discomfort, self-efficacy and enjoyment by completing four brief forms (copies attached).

3) Practice the PACER shuttle run.

In the second class, your daughter or son will:

1) Run the PACER for as long as she/he decides to do so.

2) Rate her/his actual discomfort, self-efficacy and enjoyment by again completing the same four brief forms (copies attached).

.

- **What are the possible risks, side effects and discomforts of this research study?**

It is *very rare* for healthy children to experience abnormal responses during the PACER exercise. However, it is important to note potential risks that may occur as a result of a submaximal exercise:

- ***Risks of the Exercise:***

1. Shortness of breath, dizziness and/or fainting. The likelihood of this occurring is rare (less than 1% of people, 1 out of 100).
2. Chest pain. The likelihood of this occurring is rare (less than 1% of people, 1 out of 100).
3. Muscle fatigue in the legs. The likelihood of this occurring is infrequent (1-10% of people, 1-10 out of 100).
4. Muscle cramping. The likelihood of this occurring is infrequent (1-10% of people, 1-10 out of 100).
5. Falling. The likelihood of this occurring is rare (less than 1% of people, 1 out of 100).

Ms. Kane will assure that PACER instructions are clearly delivered and that course preparation is obstacle free. Instructions to inform the on-site teacher and/or the investigator concerning any of the above symptoms during the testing will be explained. Although unlikely, if an abnormal response (for example, shortness of breath, chest pain, dizziness, or extreme muscle cramping) does occur during the PACER, the test will be stopped immediately and your child cared for as would be done in any physical education class. As per Falk Laboratory School policy and procedure, first aid or additional emergency assistance would be provided.

- **What are the possible benefits from taking part in this study?**

General knowledge about discomfort, self-belief in exercise ability, and enjoyment and their effect on participation during exercise may help in the development of physical education programs. Such programs are specifically designed to promote children's participation in physical activity. An additional benefit is to use the number of PACER laps that were run to provide an assessment of your child's aerobic fitness relative to national standards. Further, information collected regarding physical activity habits may help reveal health behaviors that promote a healthier lifestyle. This information will be shared with you as appropriate.

- **Who will know about my participation in this research study?**

Any information obtained from or for this study will be kept as confidential. Upon entrance into the study, a study ID number will be assigned. This ID number (and not your daughter or son's name) will be used on all of the information collected in the study.

- **May my child withdraw from the study?**

Participation in this research study including the use of identifiable information for the purposes described above is *completely voluntary*. *At any time, consent for participation in this research study, including the use and disclosure of information for the purposes described above may be withdrawn.* Inability to perform the PACER shuttle run constitutes the withdrawal of your child from this study. Any questions you have about rights as a research participant will be answered by the Human Subjects Advocate, Institutional Review Board (IRB) Office at 1-866-212-2668.

- **Permission to Participate in this study**

Your son or daughter may participate in Ms. Kane's study upon your signing the consent below. An addressed and stamped envelope is enclosed for your convenience to return the form below to the school by [DATE]. Please feel free to ask any future questions about this research by contacting Ms. Kane or me at the Falk Laboratory School. The consent document must be returned via mail or fax (412-624-1303) before your son or daughter participates in this research study.

Sincerely,

Wendell R. McConnaha
Director, Falk Laboratory School

(Please detach the consent form BELOW and mail in the enclosed envelope or fax.)

- I have read the information in this letter and any questions I had, including explanation of all terminology, have been answered to my satisfaction. A copy of this consent will be provided to me.
- I understand that questions about any aspect of this research study are encouraged during the course of the study, and that those questions will be answered by the researcher listed on the first page of this letter.
- I understand that participation in this study is voluntary and that my daughter/son is free to refuse to participate or to withdraw from participation in this study at any time without affecting future relationships with this institution.

I give my son/daughter____
PRINT Name

permission to participate in Ms. Kane's study: Predicted and Actual Exercise Discomfort, Self-Efficacy, and Enjoyment in Middle School Children: A Match-Mismatch Paradigm.

_______________________________________ _________________________________
Parent(s)/Guardian(s) Signature/Date Son/Daughter Signature/Date

APPENDIX F

GROUP DATA FORM

GROUP DATA FORM																			
Ss ID	GENDER	AGE yr	HT cm	WT kg	BMI kg·m²	PA hr/wk	**Predicted** Discomfort			**Pre-** Self-Efficacy Score	**Pre-** Enjoyment Score	LAPS	VO_2	**Actual** Discomfort			**Post** Self-Efficacy Score	**Post** Enjoyment Score
							RPE	X RMH =	DI					RPE	X RMH =	DI		
1																		
2																		
3																		
4																		
5																		
6																		
7																		
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APPENDIX G

PHYSICAL ACTIVITY & EXERCISE QUESTIONNAIRE (2)

"Please write your name and date on the Physical Activity and Exercise form before you. It has 2 pages. The first page has four multiple choice questions. Please read each question carefully and circle the answer that best describes you. Question four also asks you to list activities. When you are done with Page 1, wait for instructions for Page 2."

PHYSICAL ACTIVITY & EXERCISE

ID:________________________________ **DATE**________________________

1. How many of the past 14 days have you done at least 20 minutes of exercise hard enough to make you breath heavily and make your heart beat fast? (Hard exercise includes, for example, playing basketball, jogging, fast dancing or bicycling; include time in physical education class)

   1. None
   2. 1 to 2 days
   3. 3 to 5 days
   4. 6 to 8 days
   5. 9 or more days

2. How many of the past 14 days have you done at least 20 minutes of light exercise that was not hard enough to make you breath heavily and make your heart beat fast? (Light exercise includes, for example, playing baseball, walking or slow bicycling; include time in physical education class)

   1. None
   2. 1 to 2 days
   3. 3 to 5 days
   4. 6 to 8 days
   5. 9 or more days

3. During a normal week, how many hours a day do you watch television and videos, or play computer or video games before and after school?

   1. None
   2. 1 hour or less
   3. 2 to 3 hours
   4. 4 to 5 hours
   5. 6 or more hours

4. During the past 12 months, how many team or individual sports or activities did you participate in on a competitive level, such as varsity or junior varsity sports, intramurals, YMCA or other out-of-school programs.

   1. None
   2. 1 activity
   3. 2 activities
   4. 3 activities
   5. 4 or more activities

What activities did you compete in?
1. ____________
2. ____________
3. ____________
4. ____________
5. ____________
6. ____________
7. ____________

Page 2

PAST YEAR LEISURE-TIME PHYSICAL ACTIVITY

ID:________________________________

"This page asks you to 'Check all activities that you did <u>at least 10 times</u> in the PAST YEAR. Do not include time spent in school physical education classes. Make sure you include all sport teams that you participated in during the LAST YEAR. Check the months you did the activity and then go to the next section to estimate the time spent in each activity. Do you have any questions about completing this section?"

____ Aerobics
____ Band/Drill Team
____ Baseball
____ Basketball
____ Bicycling
____ Bowling
____ Cheerleading
____ Dance Class
____ Football
____ Garden/Yard Work
____ Gymnastics
____ Hiking
____ Ice Skating
____ Roller Skating
____ Running for Exercise
____ Skateboarding
____ Snow Skiing
____ Soccer
____ Softball
____ Street Hockey
____ Swimming (Laps)
____ Tennis
____ Volleyball
____ Water Skiing
____ Weight Training
____ Wrestling (Competitive)

<u>Others</u>
____
____
____

List each activity that you checked above in the "Activity" box below, check the months you did each activity and then estimate the amount of time spent in each activity.

Activity	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Months Per Year	Days Per Week	Minutes Per Day

APPENDIX H

PACER SCORE SHEET (111)

The PACER Individual Score Sheet

Research Assistant________________________ Class period________ Date__________

Laps (20-meter lengths)

1	1	2	3	4	5	6	7							
2	8	9	10	11	12	13	14	15						
3	16	17	18	19	20	21	22	23						
4	24	25	26	27	28	29	30	31	32					
5	33	34	35	36	37	38	39	40	41					
6	42	43	44	45	46	47	48	49	50	51				
7	52	53	54	55	56	57	58	59	60	61				
8	62	63	64	65	66	67	68	69	70	71	72			
9	73	74	75	76	77	78	79	80	81	82	83			
10	84	85	86	87	88	89	90	91	92	93	94			
11	95	96	97	98	99	100	101	102	103	104	105	106		
12	107	108	109	110	111	112	113	114	115	116	117	118		
13	119	120	121	122	123	124	125	126	127	128	129	130	131	
14	132	133	134	135	136	137	138	139	140	141	142	143	144	
15	145	146	147	148	149	150	151	152	153	154	155	156	157	

Lane______ID:_________________________________Laps Completed________

APPENDIX I

PACER VIDEO DEVELOPMENT

The PACER video, a component of the PRE-EXERCISE assessment, was developed for two purposes: 1) to complement the verbal description/instructions provided to the subjects prior to PACER practice and actual PACER EXERCISE Test; and, 2) to provide a PACER EXERCISE Test visualization upon which the subjects will predict expected discomfort, self-efficacy and enjoyment while performing the actual PACER EXERCISE Test.

The development of the PACER video involved two phases: 1) creation of the PACER video; and 2) validation of the PACER video as a visual medium for prediction of PACER discomfort, self-efficacy and enjoyment ratings.

I) Creation of the PACER video:

One female (13 years old) and one male (11 years old) performed the PACER for video recording. The female volunteer reported previous participation in a variation of shuttle fitness (not PACER) testing: "ran timed laps by the teacher" at her school. The male volunteer reported no recollection of PACER or shuttle run participation. Both subjects were instructed to wear comfortable exercise clothing appropriate for physical activity and athletic shoes appropriate for walking/running.

The setting for the video performance was a local suburban middle school gymnasium. A middle school teacher was present during video preparation and taping.

The pre-taping preparations included:

1) Setting up two forty inch course lanes for PACER performance as noted in the course design in Figure 3.5. Two course lanes were measured, taped lines applied to the floor, and lane cones positioned by the investigator and double-checked for accuracy by the middle school teacher;

2) The CD was checked for adequate audio volume and timing. The first minute beep interval was verified with the school clock by the investigator.

PACER video taping involved:

1) The middle school teacher, the investigator, the subjects, and the video technician arrived at the school gymnasium at approximately 9:15 am;

2) As the video technician prepared the video equipment, PACER verbal instructions as described in the PRE-EXERCISE script were reviewed with the subjects and questions were answered;

3) The subjects then listened to the PACER CD for one minute to assure familiarity with the beeps and music;

4) The subjects then ran two CD-directed practice laps to assure understanding of PACER verbal and CD directions;

5) The subjects were instructed to stand at their course lane where the investigator briefly stated: “OK, we are ready to do the PACER. Remember, run your laps to the beeps and run as long as you can. We’re turning on the CD; be ready to run as soon as you hear “On your mark…get ready…START!”

6) Following the investigator statement, the middle school teacher started the PACER CD;

7) Upon hearing the CD instructions “On your mark…get ready…START!” the subjects began the PACER;

8) The video taping continued until completion of the PACER by both subjects. The female subject completed 16 laps (2 levels) and the male subject completed 52 laps (6 completed levels and first lap of the seventh level);

The original PACER (7 minutes 52 seconds) video was subsequently edited to a 5 minute 22 second presentation. The edit consisted of shortening the investigator’s introduction per teacher and subject recommendation and eliminating 1.5 minutes of laps performed by the male subject.

II) The edited PACER video was then validated as a visual prompt from which subjects could predict their PACER EXERCISE Test discomfort, self-efficacy and enjoyment ratings. The validation of the PACER video involved the following steps:

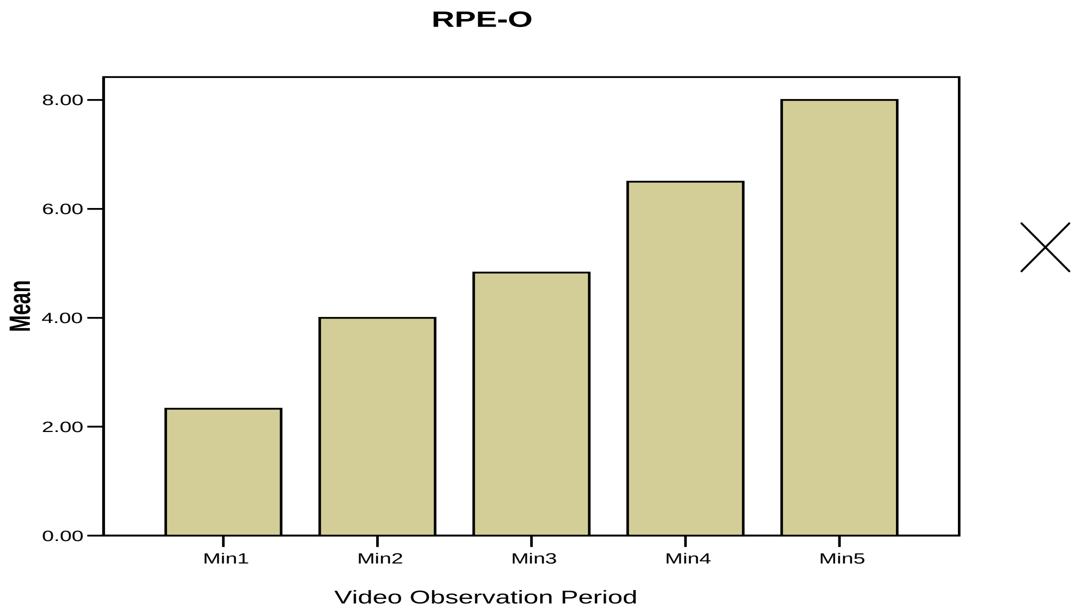
1) Six new subjects (two females aged 10 and 14 years and four males, three 12 year olds and one 13 year old) listened to the PACER verbal instructions and viewed the PACER video as described in the PRE-EXERCISE script sections 1 and 3 of Chapter III.

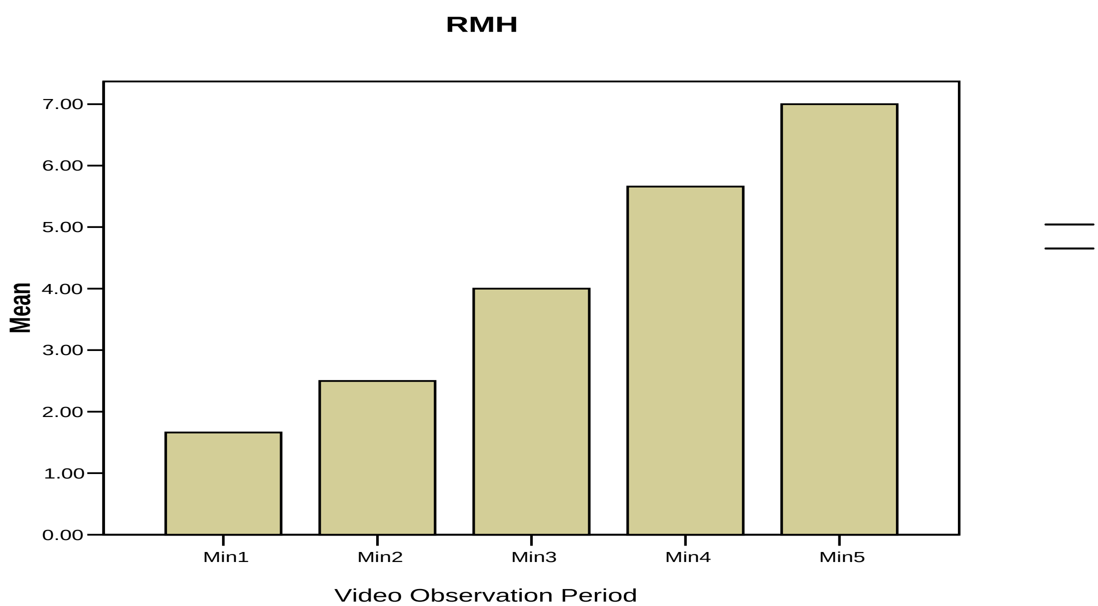
2) Following PACER verbal instructions, the PACER video was viewed and stopped at one minute intervals;

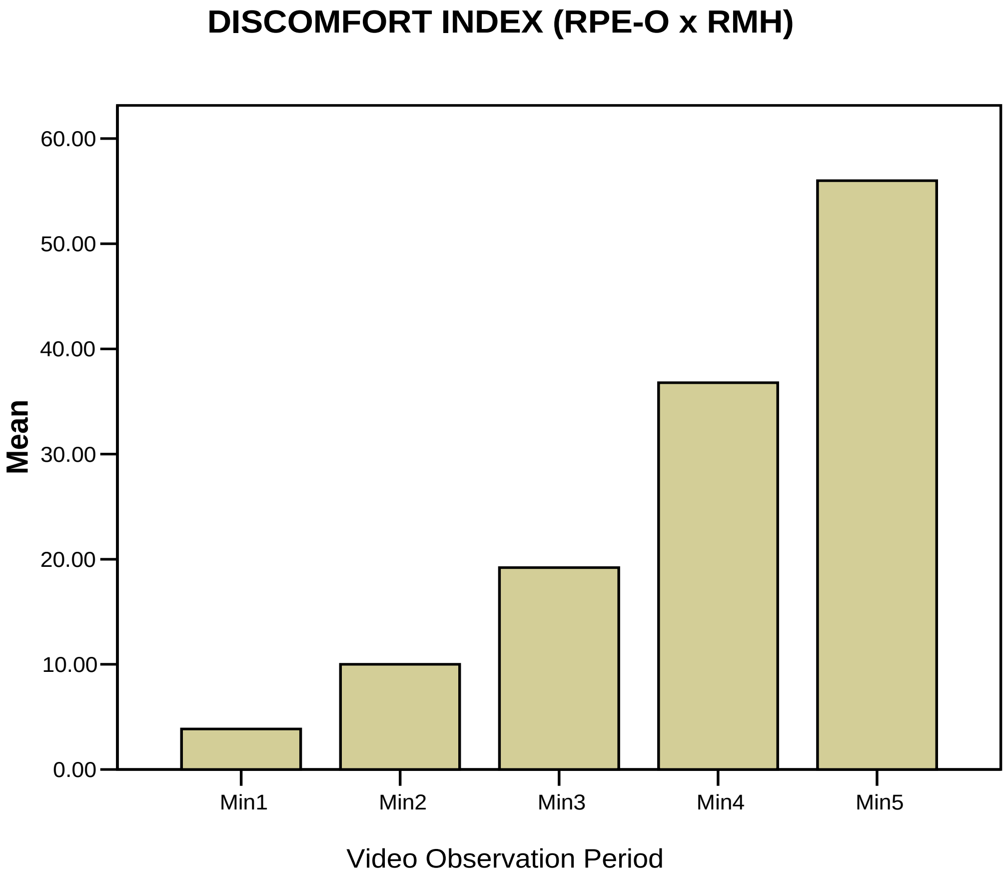
3) Upon stopping the tape, the subjects completed the Exercise Discomfort Index, and the Exercise Self-Efficacy and Enjoyment questionnaires.

Subjects’ *predictions* of their PACER EXERCISE Test discomfort, self-efficacy and enjoyment are presented in the following figures:

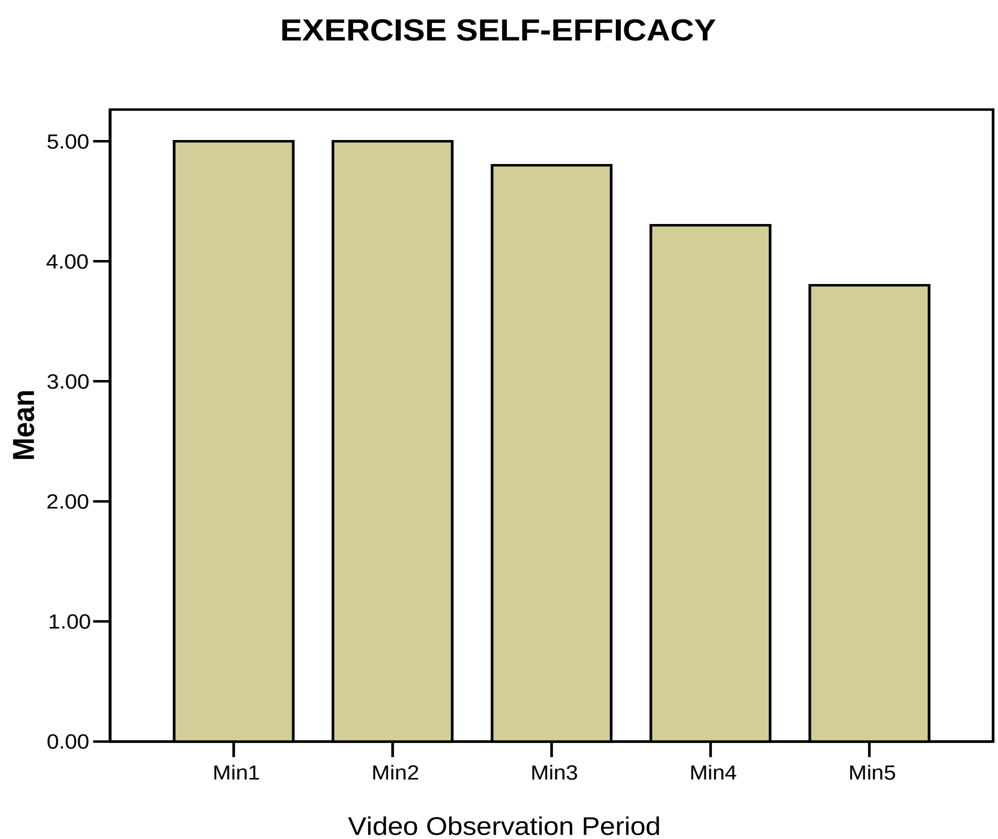
A) RPE-O X RMH = Discomfort Index (DI): The ***y*** axes of the following three graphs respectively present group mean RPE-O (0-10), RMH (0-10) and DI (0 -100) responses for each minute of a five minute PACER video observation period. The ***x*** axes indicate the minute-by-minute observation period. Mean values were obtained by totaling each subject's reported rating for each minute of the five minute PACER video observation and dividing by the total number of subjects.





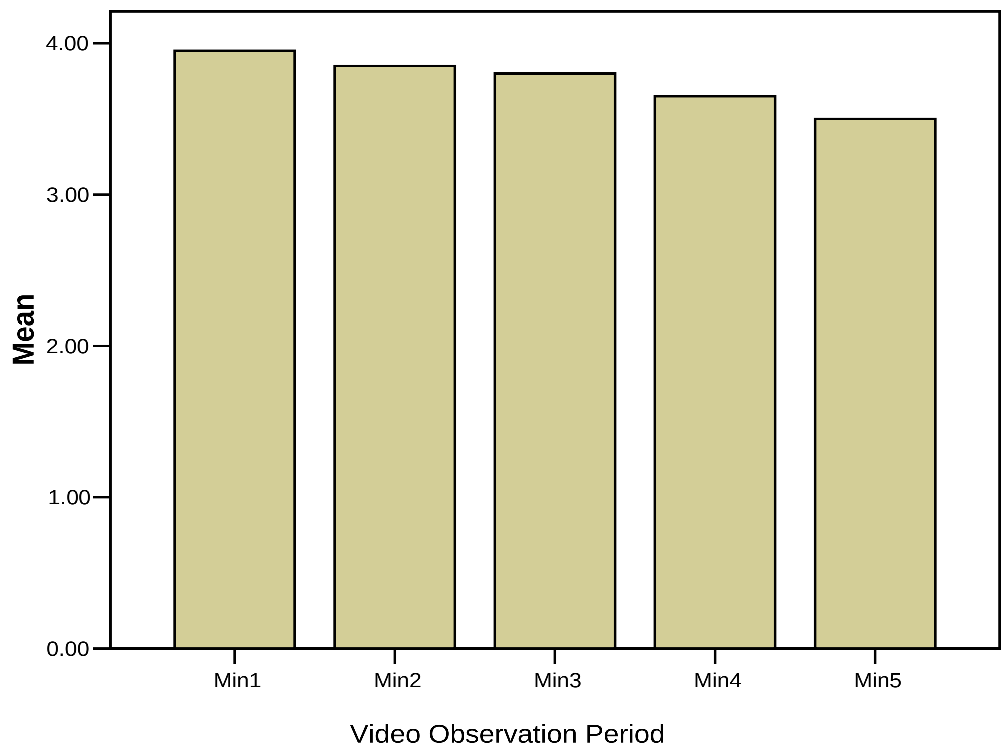

DISCOMFORT INDEX (RPE-O x RMH)
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Mean
Min1
Min2
Min3
Min4
Min5
Video Observation Period

C) Exercise Self-Efficacy: The ***y*** axis of the following graph presents group means for Exercise Self-Efficacy (1-5 Likert) responses for each minute of a five minute PACER video observation period. The ***x*** axis indicates the minute-by minute observation period. Mean values were obtained by totaling each subject's reported response for each minute of the five minute PACER video observation and dividing by the total number of subjects.



D) The ***y*** axis of the following graph presents group means for Exercise Enjoyment (1-5 Likert) responses for each minute of a five minute PACER video observation period. The ***x*** axis indicates the minute-by-minute observation period. Mean values were obtained by totaling each subject's reported response for each minute of the five minute PACER video observation and dividing by the total number of subjects.

EXERCISE ENJOYMENT



The data indicated that as the visualized intensity of the PACER test increased:

1) Predicted RPE-O (2.3 to 8.0), RMH (1.6 to 7.0), and DI (3.68 to 56.0) increased;

2) Predicted Exercise Self-Efficacy decreased from 5 to 3.8;

3) Predicted Exercise Enjoyment decreased from 3.95 to 3.5.

Subjects were able to predict their exercise discomfort, self-efficacy and enjoyment from the PACER video and accompanying verbal/CD instructions. Therefore, the PACER verbal/CD instructions and the video appear to provide a valid subjective criterion upon which subjects in the current study can predict their Exercise Discomfort, Self-Efficacy and Enjoyment on Day 1 PRE-EXERCISE.

APPENDIX J

1. Types of Competitive Activities Reported by Total Group

Competitive Activities	Responses		Percent of Cases
	N	Percent	
Baseball	5	8.3%	17.2%
Basketball	19	31.7%	65.5%
Dancing (dance class)	3	5.0%	10.3%
Football	2	3.3%	6.9%
Golf	1	1.7%	3.4%
Soccer	13	21.7%	44.8%
Softball	1	1.7%	3.4%
Swimming (laps)	2	3.3%	6.9%
Tennis	3	5.0%	10.3%
Lacrosse	1	1.7%	3.4%
Fencing	1	1.7%	3.4%
Running (cross-country)	7	11.7%	24.1%
Hockey (Ice)	2	3.3%	6.9%
Total	60	100.0%	206.9%

2. Leisure Physical Activity Calculations: from Aaron, D. J. et al (1993). The epidemiology of leisure physical activity in an adolescent population. Medicine and Science in Sports and Exercise, 25, p.853 (2).

LEISURE PHYSICAL ACTIVITY CALCULATIONS

1. For each activity:

$$\frac{(\#\ \text{months/yr}) \times (4.3\ \text{wks/month}) \times (\#\ \text{days/wk}) \times (\#\ \text{minutes/day})}{(60\ \text{minutes/hr}) \times (52\ \text{wks/yr})} = \text{hrs/wk of activity}$$

2. Sum the hrs/wk for each activity to determine the total physical activity estimate for the past year.

3. Types of Leisure Activities Reported by Total Group

		Responses		
	Activity	**n**	**%**	**Percent of Cases**
3	Baseball	6	3.0%	17.6%
4	Basketball	22	10.9%	64.7%
5	Bicycling (street)	10	5.0%	29.4%
6	Bicycling (trail)	4	2.0%	11.8%
7	Bowling	4	2.0%	11.8%
8	Dancing (dance class)	7	3.5%	20.6%
10	Football	12	5.9%	35.3%
12	Garden/yard work	9	4.5%	26.5%
13	Golf	1	.5%	2.9%
14	Gymnastics	2	1.0%	5.9%
15	Hiking	13	6.4%	38.2%
17	Horse-back riding	1	.5%	2.9%
18	Hunting	1	.5%	2.9%
19	Ice skating	6	3.0%	17.6%
20	Martial arts	1	.5%	2.9%
22	Running for exercise	14	6.9%	41.2%
23	Skateboarding	5	2.5%	14.7%
24	Sled-riding	1	.5%	2.9%
25	Snow skiing (downhill)	6	3.0%	17.6%
26	Soccer	18	8.9%	52.9%
28	Hockey (street)	5	2.5%	14.7%
29	Swimming (laps)	8	4.0%	23.5%
31	Tennis	12	5.9%	35.3%
32	Volleyball	1	.5%	2.9%
34	Skiing (water)	2	1.0%	5.9%
35	Weight-lifting	3	1.5%	8.8%
37	Other	2	1.0%	5.9%
38	Roller-skating/blading	8	4.0%	23.5%
41	Snow-boarding	4	2.0%	11.8%
44	Lacrosse	1	.5%	2.9%
45	Band/Drill team	4	2.0%	11.8%
47	Hockey (field)	1	.5%	2.9%
53	Table tennis	1	.5%	2.9%
60	Aerobic machines(cardio)	1	.5%	2.9%
64	Fencing	1	.5%	2.9%
70	Running (cross-country)	4	2.0%	11.8%
75	Hockey (Ice)	1	.5%	2.9%

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