

**RELATIONSHIPS BETWEEN DOMAIN-SPECIFIC PHYSICAL ACTIVITY
AND MENTAL HEALTH, MENTAL WELLBEING, AND MENTAL-ILL
HEALTH: UNDERSTANDING THE ROLE OF SELF-DETERMINED
MOTIVATION**

Submitted by

Rhiannon Lee White

Bachelor of Health Science (PDHPE) (Honours)

A thesis submitted in total fulfillment of the requirements of the degree of

Doctor of Philosophy

Institute for Positive Psychology and Education

Faculty of Health Sciences

Australian Catholic University

25th November, 2016

Graduate Research

Level 20-20.21, Tension Woods House, 8-20 Napier Street, North Sydney, Australia

Dedicated to my mum, Sharon White,
and to anyone who wishes to improve their mental health through physical activity.

Acknowledgements

First and foremost, I would like to express my sincerest of thanks to my mum, Sharon White, for giving me everything I needed to complete this phase of both my education and my life. Thank you for making my education a priority even when times were tough and for fighting timelessly to give me every opportunity I desired. If it weren't for your dedication as a mum I would not have been able to become the person I have, or pursue the educational pathways I have. You have also been my biggest source of strength throughout this journey, both in person and in spirit. Not only were you the most encouraging and supportive person possible, but your words, and your strength and belief in me have stuck by long since and have pushed me further each day. I feel immensely privileged to have had your support throughout my life and I am extremely proud to be your daughter and to continue caring about others as you did, both in my personal life and through my research.

I would also like to acknowledge all of my supervisors: Chris Lonsdale, Philip Parker, Rebecca Olson, and Thomas Astell-Burt. Thank you, Chris for providing me with the independence to develop a thesis topic that I could not be more passionate about. Thank you also to each of you for your feedback, guidance, interest, and belief in me, as well as the expertise you each brought to my candidature. The knowledge and skills you have all passed on are invaluable.

To my sister, Kaitlyn Jane White, I will always be hugely appreciative of the sacrifices you made which enabled me to continue my candidature. Without you, mum, and myself sticking together, this thesis would not have been possible.

I would like to express my sincerest of thanks to two of my wonderful friends, Ryan Elston and Karolyn Vaughan, who were my greatest of supporters and motivators throughout my PhD. Ryan, I cannot express how grateful I am to have met you, and to

have become such good friends. The difference it has made to have a friend who has stood by me with every decision and every bump along the way. I would possibly not be submitting this thesis if it weren't for you reminding me why I'm doing this and making me remember how much I care about it. Karolyn, I never thought 3 years ago your support would have been as crucial as it was. You've become somewhere between a second mother and a best friend, as well as someone who completely understands the crazy PhD process and the highs and lows that go with it. Your support and understanding have been so important.

I am also extremely grateful for my fellow PhD candidates, Katherine Owen and Aidan Lester, who worked with me on the AMPED project. Thank you both for your hard work, encouragement, and humour which made lengthy data collection months bearable. Extra thanks to Katherine Owen for being a good source of support to run ideas by and vent to. Additionally, I'd like to extend a sincere thank you to Ian Moyes for his hard work and dedication as the AMPED project officer and for his unconditional support during data collection. To my fellow PhD candidates at Western Sydney University and Australian Catholic University, I feel so fortunate to have gained such wonderful memories. You've all contributed to making this process so enjoyable.

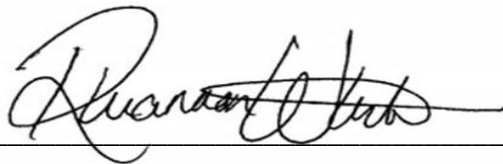
Thank you to Western Sydney University, Australian Catholic University, and the Commonwealth Government for financially supporting my thesis, funding equipment, and enabling me to present my research at an international conference. I am also grateful to the support provided by a number of staff members including Peter Longeran, Ferina Khayum, and Eva Lu. Thank you to all of the school students who participated and made this research possible, and to the teachers who contributed valuable time. Finally, thank you to my examiners for providing valuable comments that enhanced this thesis.

Statement of Authorship and Sources

This thesis contains no material published elsewhere or extracted in whole or in part from a thesis by which I have qualified for or been awarded another degree or diploma.

No parts of this thesis have been submitted towards the award of any other degree or diploma in any other tertiary institution. No other person's work has been used without due acknowledgment in the main text of the thesis. All research procedures reported in the thesis received the approval of the Australian Catholic University Human Research

Ethics Committee. Editorial advice was received from Alan Crosier in the form of recommendations to improve language only and some suggestions were accepted by the author.

A handwritten signature in black ink, appearing to read 'Rhiannon Lee White', written over a horizontal line.

Rhiannon Lee White

25.11.16

Table of Contents

Acknowledgements	iii
Statement of Authorship and Sources	v
Table of Contents.....	vi
List of Tables	xiii
List of Figures.....	xiv
Abbreviations.....	xv
Operational Definitions of Key Terms	xvi
Thesis Abstract	1
CHAPTER 1: Introduction.....	4
Overview	4
Background.....	5
Mental Ill-Health	5
Mental health disorders.	5
Mental health problems.	6
Mental Health	7
Affective Wellbeing.	7
Physical Activity.....	8
Physical Activity and Mental Health.....	8
Mechanisms relating physical activity and mental health.	9
Dose-response relationship.....	11
Physical Activity Domains	13
Self-Determination Theory.....	14
Gaps in the Literature	19
Overview of Thesis.....	20
Thesis Aim.....	20
Specific Research Objectives	20
Study 1	20
Study 2.....	20

Study 3	21
Study 4	21
Significance of the Thesis.....	21
Outline of Thesis Chapters	22
Synopsis.....	23
CHAPTER 2: Meta-Analysis.....	24
Abstract.....	24
Context.....	25
Evidence Acquisition.....	26
Inclusion Criteria	27
Exclusion Criteria	28
Search Strategy	28
Study Selection	29
Data Extraction	29
Statistical Analysis	30
Effect sizes.....	30
Random effects multilevel model.....	30
Assessing heterogeneity.	31
Moderator analyses: Mixed effects multilevel models.....	31
Publication bias.....	32
Risk of Bias of Individual Studies.....	32
Evidence Synthesis	34
Studies Included	34
Risk of Bias Assessment.....	35
Effect Sizes, Heterogeneity, and Moderator Analyses	35
Mental ill-health.	37
Mental health.	40
Discussion.....	44

Strengths and Limitations	48
Conclusions	49
Synopsis.....	50
CHAPTER 3: Qualitative Investigation	51
Abstract.....	51
Introduction	52
Methods	54
Participants	55
Procedure.....	55
Computer-Assisted-Self-Interview Questions.....	56
Data Analysis.....	58
Results	59
Research Question 1: Physical Activity and Affective Wellbeing.....	59
Positive affect.	59
Negative affect.....	62
Research Question 2: Domain-Specific Physical Activity and Affect.....	63
Research Question 3: The Role of Self-Determined Motivation	65
Leisure-time.....	68
Active travel to school.....	69
Physical education.....	70
Discussion.....	71
Strengths and Limitations	74
Conclusions	75
Synopsis.....	76
CHAPTER 4: Scale Development	77
Abstract.....	77
Introduction	78
Phase 1: Item Development.....	81

Methods	81
Data Analysis.....	82
Results	83
Phase 2: Initial Validity Evidence	86
Methods	86
Participants.	86
Measure.	86
Data Analysis.....	87
Results	88
Phase 3: Cross Validation.....	90
Methods	90
Participants.	90
Measures.....	90
Data Analysis.....	91
Results	92
Discussion.....	95
Strengths and Limitations	96
Conclusions	97
Synopsis.....	97
CHAPTER 5: Moderator Analyses.....	98
Abstract.....	98
Introduction	99
Methods	102
Participants	102
Procedures	103
Measures.....	103
Active travel physical activity.	103
Leisure-time physical activity.	104

Self-determined motivation towards active travel.....	104
Self-determined motivation towards leisure-time physical activity.....	105
Positive and negative affect.....	105
Covariates.....	105
Data Preparation.....	106
Data Analysis.....	106
Results.....	108
Active Travel.....	108
Leisure-time Physical Activity.....	112
Discussion.....	113
Strengths and Limitations.....	117
Conclusions.....	119
Synopsis.....	119
CHAPTER 6: Discussion and Conclusions.....	121
Overview of Findings.....	121
Discussion of Main Findings.....	122
Physical Activity Guidelines.....	122
Evolution of the Guidelines.....	123
Public Messages.....	125
Any activity counts.....	125
Move more, sit less.....	126
The Importance of Life Domain.....	128
The Role of Motivation.....	128
“ <i>Move More</i> ” or “ <i>Move More in Ways You Enjoy</i> ”?.....	129
Future Directions.....	131
Strengths and Limitations of this Thesis.....	137
Concluding Remarks.....	139
References.....	141

CHAPTER 7: Appendices.....	186
Appendix A: Additional Information Regarding Methodology and Design.....	187
Conceptual Framework.....	187
Methodological Approach.....	188
Ethics Approval.....	189
Sampling Procedures.....	189
Study 1.....	189
Study 2.....	190
Study 3.....	190
Study 4.....	191
Data Analysis.....	191
Missing Data.....	191
Structural Equation Modelling (SEM).....	191
Study 1.....	191
Study 2.....	195
Study 3.....	196
Study 4.....	199
Appendix B: Supplementary Material (Study 1).....	203
Appendix C: Ethics Approval Letter.....	220
Appendix D: Information Statement and Consent Form (Study 2).....	222
Appendix E: Computer-Assisted-Self-Interview Questions.....	227
Appendix F: Information Statement and Consent Form (Study 3).....	232
Appendix G: Motivation towards Active Travel to School Scale (MATSS): Instrument and Scoring Key.....	237
Appendix H: Information Statement and Consent Form (AMPED participants)	238
Appendix I: Behavioural Regulation in Exercise Questionnaire-2 (BREQ-2): Instrument and Scoring Key.....	244
Appendix J: Travel Diary.....	245

Appendix K: Adaptation of the WHO Health Behaviour in School Children (HBSC) Questionnaire.....	247
Appendix L: Positive and Negative Affect Scale (PANAS): Instrument and Scoring Key.....	248
Appendix M: International Society of Behavioral Nutrition and Physical Activity Conference Abstract	249

List of Tables

Table 1	Domain-Specific Physical Activity and Mental Ill-health Meta-Analyses.....	38
Table 2	Domain-Specific Physical Activity and Mental Health Meta-Analyses.....	41
Table 3	Frequency Counts of the Most Common Words Used to Explain When Physical Activity Leads to Positive Affect as Opposed to Negative Affect	64
Table 4	The Association between Domain-Specific Physical Activity and Affect	65
Table 5	The Association between Affect and three Physical Activity Domains according to Participants' Main Reason for Participation	67
Table 6	Mean Ratings and Content Validity Coefficients of the Initial Items.....	84
Table 7	Effect Size Indices of the Initial Items.....	85
Table 8	Goodness of Fit Statistics for the Revised 9-item Three Factor Model.....	89
Table 9	Items, Factor Loadings, and Descriptive Statistics of the 9-item MATSS scores ...	89
Table 10	Correlation Matrix between Motivation Factors.....	94
Table 11	Correlations between Physical Activity, Affect, and Motivation	109
Table 12	Relationships between Domain-Specific Physical Activity and Affect.....	110
Table 13	Structural Equation Modelling Results Demonstrating whether Motivation Moderates the Relationship between Self-reported Domain-Specific Physical Activity and Affect	111
Table 14	Structural Equation Modelling Results Demonstrating whether Motivation Moderates the Relationship between Objectively Measured Domain-Specific Physical Activity and Affect.....	112
Table B1	Full List of Systematic Review Search Terms.....	203
Table B2	Summary of Studies Included in the Systematic Review	206
Table B3	Number of Studies examining each Mental Health Variable within each Physical Activity Domain	214
Table B4	Risk of Bias of Included Studies	215

List of Figures

Figure 1	The taxonomy of human motivation, adapted from Ryan & Deci (2000).....	16
Figure 2	Flow diagram of articles throughout the systematic review.....	34
Figure 3	Correlations and 95% CIs within specific physical activity domains for mental health and mental ill-health.	36
Figure 4	Why adolescents’ perceive that physical activity is associated with positive and negative affect.	60
Figure 5	Diagram of structural equation model testing moderation.	108
Figure 6	Global physical activity guidelines for children, adolescents, and adults (World Health Organization, 2010).	123
Figure 7	Excerpt from Australia’s physical activity guidelines for adolescents (Department of Health and Ageing, 2014).	125
Figure 8	Series of screenshot images from the “It All Adds Up” campaign television advertisement (Public Health Agency, 2010).....	126
Figure 9	Tasmanian government print media promoting “move more, sit less” (The Department of Premier and Cabinet, 2015).....	127
Figure 10	The Heart Foundation’s image featuring the “move more, sit less” slogan (Heart Foundation, 2015).....	130
Figure 11	First adaptation of the Heart Foundation’s image featuring the “move more, sit less” slogan representing the difficulty of crafting specific but catchy slogans to promote to the public (Heart Foundation, 2015).	130
Figure 12	Second and more realistic adaption of the Heart Foundation’s image featuring the “move more, sit less” slogan (Heart Foundation, 2015).....	131
Figure A1	Conceptual framework of the main concepts and relationships investigated within this thesis.....	188
Figure A2	Structural equation model with interaction between latent variables.....	201
Figure B1	Individual study effect size estimates.....	219

Abbreviations

Abbreviation	Full Term
AMPED	Activity and Motivation in Physical Education
BREQ	Behavioural Regulation in Exercise Questionnaire
CFA	Confirmatory factor analysis
CFI	Comparative fit index
MATSS	Motivation towards Active Travel to School Scale
PA	Physical activity
PE	Physical education
RMSEA	Root mean squared error of approximation
SDT	Self-determination theory
SEM	Structural equation modelling
SRMR	Standardised root mean square residual

Operational Definitions of Key Terms

Affective wellbeing: A crucial component of mental wellbeing, understood as the ratio of positive affect to negative affect (Luhmann, Hawkley, Eid, & Cacioppo, 2012).

Active travel: Any physically active mode of transport to or from school (e.g., walking, cycling, scooter, or skateboarding), either in isolation or in combination with public transport (e.g., walking to catch a bus) (Hardy, King, Espinel, Cosgrove, & Bauman, 2011; Merom, Tudor-Locke, Bauman, & Rissel, 2006).

Amotivation: A lack of intention to act resulting in an individual either not participating at all, or acting despite having no intention to do what they are doing (Deci & Ryan, 2002b).

Autonomous motivation: Acting “with a full sense of volition and choice because the activity is interesting or personally important” Williams (2002, p. 235).

Controlled motivation: “Engaging in an activity for internal (e.g., guilt) or external pressure (e.g., external rewards)” (Gillet, Vallerand, Lafrenière, & Bureau, 2012, p. 455).

Leisure-time physical activity: Physical activity outside of school hours, excluding travel to and from school (Bohnert, Richards, Kolmodin, & Lakin, 2008; Goodin, Rice, Parpo, & Eriksson, 2008).

Mental health: “A state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community” (Herrman, Saxena, & Moodie, 2005, p. 2).

Mental ill-health: A broad term, encompassing both diagnosable mental health disorders and less severe mental health problems (Barry & Jenkins, 2007; Fontaine, 2009; World Health Organization, 2004).

Negative affect: Non-specific aversive states, such as fear, sadness, anger, and guilt (Gray & Watson, 2001).

Physical activity: Any muscular movement that expends energy (Shephard, 2003).

Physical activity domain: Any area of life that provides opportunities for physical activity (e.g., leisure-time, work, school, and transport).

Positive affect: A pleasant mental state such as cheerfulness, happiness, enthusiasm, and alertness (Gray & Watson, 2001).

Thesis Abstract

Background: Mental ill-health is the leading cause of disability worldwide due to the high prevalence of mental health disorders and the reduced quality of life that accompanies a diagnosis. Alarming, many mental health disorders first originate during adolescence, causing a particularly high prevalence amongst young people. Abundant evidence demonstrates that physical activity benefits adults' and adolescents' mental health and wellbeing. However, little is known about the specific circumstances under which physical activity optimally promotes mental wellbeing. Without such understanding it is impossible to optimally promote mental health and prevent mental ill-health through physically active behaviours. Limited evidence suggests that leisure-time physical activity is more beneficial to mental health and wellbeing than physical activity during other life domains. It has been suggested that leisure-time physical activity may be a more self-determined behaviour compared to physical activity during other domains, and that this higher quality motivation may explain why leisure-time physical activity is more strongly associated with improved wellbeing. However, the role motivation plays in the relationship between domain-specific physical activity and mental health has not yet been examined.

Objective: The overarching objectives of this thesis were to examine the associations between domain-specific physical activity and mental health among adolescents, and to explore the role that motivation plays in these relationships.

Methods: First, a meta-analysis of 97 studies was conducted to systematically review the relationship between physical activity and mental health in a number of life domains (i.e., leisure-time, work, transport, household physical activity, school sport, and physical education) and quantitatively compare domains. After the influence of life domain was examined, a qualitative investigation was conducted with 114 adolescents

to explore the potential role of motivation. Next, a measure of motivation towards active travel (the Motivation towards Active Travel to School Scale) was developed and the psychometric properties of the scale were tested. This scale was developed so that motivation towards active travel could be measured in the final study. The final study, a cross-sectional investigation involving 1,632 adolescents from Western Sydney, Australia, examined the relationships between physical activity during two life domains and affective wellbeing, and whether motivation moderated these relationships. The two domains measured were leisure-time physical activity, a domain which appears to be beneficial and participation is often autonomously motivated; and active travel, a domain in which evidence regarding the relationship with mental health is mixed, and motivation has not been examined.

Results: In the meta-analysis, leisure-time physical activity emerged as the only physical activity domain which was positively associated with mental health and inversely associated with mental ill-health, demonstrating that life domain influences the relationship between physical activity and mental health. Qualitative results revealed that, compared to active travel or physical education, adolescents were more likely to perceive that leisure-time physical activity leads to positive affect. Further, physical activity behaviours that led to positive affect were undertaken due to autonomous reasons, while physical activity experiences that led to negative affect were more likely to be undertaken due to controlled motivation. Additionally, physical activity behaviours were associated with positive affect due to increased confidence and a sense of belonging, while physical activity experiences were associated with negative affect because of peer comparisons, boredom, and feeling incompetent. Confirmatory factor analysis revealed that the final 9-item MATSS model fit the data well, and the measure was invariant across gender. Therefore, the MATSS was suitable to measure adolescents' motivation towards active travel to school. Structural equation modelling

then showed that leisure-time physical activity was positively associated with positive affect and inversely associated with negative affect, while active travel was not significantly associated with affect. However, active travel had a significant positive relationship with positive affect when autonomous motivation was high. Additionally, active travel had a significant positive relationship with negative affect when controlled motivation was high.

Conclusions: This thesis demonstrated that leisure-time physical activity is more strongly associated with positive mental health and reduced mental ill-health, than physical activity accumulated in other life domains. As such, specifically promoting leisure-time physical activity is more likely to improve mental health than promoting physical activity more generally. However, this thesis also identified that autonomous motivation positively influences the relationship between active travel and affective wellbeing. Hence, encouraging autonomous participation in physical activity that individuals find enjoyable and satisfying may also be advantageous by offering mental wellbeing benefits that may not be derived from physical activity that is controlled. As such, life domain and motivation are two important variables that influence the relationship between physical activity and mental health and wellbeing, and should, therefore, be considered when developing interventions, treatment programs, and policy guidelines.

CHAPTER 1: Introduction

Overview

Mental health disorders are the largest contributor to burden of disease among children, adolescents, and young adults; and the largest cause of disability worldwide (Begg et al., 2007; M. Prince et al., 2007; Whiteford et al., 2013). In 2001, an estimated 450 million people worldwide experienced a mental health disorder (World Health Organization, 2001). With the widespread prevalence and extensive impact of mental health disorders, both on individuals' lives and on the global disease burden, mental health has become a national priority in many countries, including Australia (Commonwealth Department of Health and Aged Care and Australian Institute of Health and Welfare, 1999). Despite increased efforts to understand and prevent specific mental health disorders, as well as to promote mental health more broadly, the gap in life expectancy between the general population and those with a mental health disorder continues to widen (Lawrence, Hancock, & Kisely, 2013). The World Health Organization (2001) has declared the need for collaborative public health approaches to reduce such pervasive and costly effects of mental health disorders.

Abundant evidence shows that physical activity contributes to mental health and wellbeing (Biddle & Asare, 2011). However, little is understood about the specific circumstances in which physical activity is most beneficial. Understanding the relevant factors that influence the relationship between physical activity and mental health could lead to more specific physical activity guidelines and recommendations, with more prospect of promoting mental health. Therefore, the overarching aim of this thesis was to further the understanding of the relationship between physical activity and mental health by examining the influence of two potentially important variables: the life

domain in which physical activity is undertaken, and motivation towards physical activity.

This introductory chapter has two main sections. Firstly, a background section sets the overall context for this thesis by highlighting literature relating to physical activity, mental health, and self-determination theory. Secondly, an overview of this thesis is presented, including study specific research objectives, an outline of the remaining chapters, and the overall significance of this research.

Background

This background section highlights the alarming prevalence of mental ill-health and the burden it imposes on society. It then stresses the importance of positive mental health, briefly reviews the literature examining the relationship between physical activity and mental health, and addresses the potential roles of life domain and motivation.

Mental Ill-Health

Mental ill-health is a broad term which consists of serious mental health disorders and more day-to-day mental health problems (Barry & Jenkins, 2007; Fontaine, 2009; World Health Organization, 2004).

Mental health disorders. Mental health disorders are clinically diagnosable illnesses associated with substantial impairment to psychological functioning (Barry & Jenkins, 2007). Globally, 27.5% of people will experience a mental health disorder in their lifetime, and 14.3% will have experienced one in the last 12-months (Kessler et al., 2009). Anxiety disorders are the most common mental health disorder category, are experienced by 8.9% of people worldwide, and are characterised by excess and irrational fear in response to a situation or stimulus (Kessler et al., 2009; McLoone &

Hudson, 2006). Affective disorders are characterised by mood disturbances ranging from extreme elation to intense depression and are the second most common category, experienced by 5.3% of people within a 12-month period (Kessler et al., 2009; McLoone & Hudson, 2006). Alarming, 11% of adolescents are experiencing an anxiety disorder at any given time (Costello, Egger, Copeland, Erkanli, & Angold, 2011) and 5.6% are experiencing depression at any given time (Costello, Erkanli, & Angold, 2006). Given their disproportionate prevalence among adolescents and young adults, mental health disorders are the largest contributor to burden of disease among those younger than 25 years (Begg et al., 2007).

Mental health disorders are the leading cause of disability worldwide, and the proportion of disability adjusted life years attributed to mental health disorders increased by 38% between 1990 and 2010 (M. Prince et al., 2007; Whiteford et al., 2013). The impact of mental health disorders is so extensive that a 14-year gap in life expectancy exists between those with a mental health disorder and the general population (Lawrence et al., 2013). The gap in life expectancy was partly due to suicide deaths; however, 80% was attributable to an increased risk of cardiovascular disease, respiratory diseases, and cancer (Lawrence et al., 2013).

Mental health problems. Mental health problems are characterised by feelings of anxiety or depression, altered behaviours, and negative or stressful thoughts, but are of shorter duration or lesser intensity than mental health disorders (Australian Institute of Health and Welfare, 2003; Department of Health and Human Services, 1999). Mental health problems are experienced by most people at some point during their life, and by 19% of adolescents at any given time (Department of Health and Human Services, 1999; Sawyer et al., 2000). Additionally, mental health problems in adolescence often progress into a prolonged mental health problem in adulthood, or a clinically

diagnosable mental health disorder (Barry & Jenkins, 2007). As a result, mental health problems in youth are often associated with a mental health disorder in adulthood (Australian Institute of Health and Welfare, 2003).

Mental Health

Mental health is a complex multidimensional construct which can be defined as “a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community” (Herrman et al., 2005, p. 2). Not only does positive mental health protect individuals against the onset of a mental health disorder (Saxena, Jané Llopis, & Hosman, 2006), it is also associated with other aspects of health and wellbeing including self-esteem, the ability to maintain positive interpersonal relationships, and a reduced risk of communicable and non-communicable diseases (Jenkins, Baingana, Ahmad, McDaid, & Atun, 2011; M. Prince et al., 2007; World Health Organization, 2001).

Affective Wellbeing. Affect is a general psychological construct referring to mental states where people feel either content or dissatisfied (Gray & Watson, 2001). As such, two broad dimensions of affect exist: positive affect and negative affect (Gray & Watson, 2001). Positive affect is a pleasant mental state including cheerfulness, enthusiasm, happiness, and alertness (Gray & Watson, 2001). Having high positive affect promotes adaptive characteristics which enable individuals to deal with negative emotions (Lyubomirsky, King, & Diener, 2005). Therefore, high positive affect is positively correlated with mental health, life satisfaction, and happiness, while low positive affect is correlated with affective disorders such as depression (Headey, Kelley, & Wearing, 1993; D. Watson, Clark, & Tellegen, 1988). Negative affect refers to the experience of negative non-specific aversive states, such as, fear, sadness, anger, and

guilt (Gray & Watson, 2001). As such, high negative affect is positively correlated with mental health disorders including depression and anxiety (Clark & Watson, 1991; Headey et al., 1993). Affective wellbeing concerns the ratio of positive affect to negative affect, as well as the frequency and intensity of experiencing positive and negative affect (Luhmann et al., 2012). Affective wellbeing is, therefore, central to mental wellbeing (Diener, 2000; Fredrickson & Losada, 2005) and is a key indicator of the extent to which an individual is experiencing positive mental health (Diener, 2000; Fredrickson & Losada, 2005).

Physical Activity

Physical activity includes any muscular movement that expends energy (Shephard, 2003). Physical activity is associated with several health benefits for adolescents including lower blood pressure, increased musculoskeletal fitness, and a reduced risk of obesity and diabetes (Biddle & Asare, 2011; Janssen & LeBlanc, 2010). However, in Australia, only 20% of children and adolescents meet physical activity recommendations by partaking in at least 60 minutes of moderate-to-vigorous physical activity each day (Schranz et al., 2014). Physical activity participation rates are also low in most countries across the globe (Hallal et al., 2012).

Physical Activity and Mental Health

In addition to the physical health benefits, physical activity is also associated with improved mental health and reduced mental ill-health. Systematic reviews have demonstrated that physical activity is positively associated with mental health (Bize, Johnson, & Plotnikoff, 2007), mental wellbeing (Thompson-Coon et al., 2011), social and emotional wellbeing (D. R. Lubans, Plotnikoff, & Lubans, 2012), self-esteem (Ekeland, Heian, Hagen, Abbott, & Nordheim, 2009), and self-concept (Babic et al., 2014). Systematic reviews have also shown an inverse association with depression and

anxiety (Biddle & Asare, 2011; Janssen & LeBlanc, 2010). Further, a number of experimental studies have shown that physical activity is beneficial to mental health and can reduce depression (Cooney et al., 2013; Lawlor & Hopker, 2001b; Windle, Hughes, Linck, Russell, & Woods, 2010). However, many of the studies supporting a causal relationship involve moderate to high levels of bias (Cooney et al., 2013) and some studies have found no association between physical activity and reduced subsequent depression (Brunet et al., 2013). Further, it is plausible that a reciprocal relationship exists given that mental health related variables influence physical activity participation and, therefore, caution needs to be applied when examining potential benefits of physical activity (Fox, 1999).

Mechanisms relating physical activity and mental health. Great effort has focused on explaining why physical activity benefits mental health (i.e., what mechanisms or mediators are responsible for this relationship) in order to understand inconsistency. Explanations may be classified as physiological, environmental, or psychological.

One explanation is the *cardiovascular hypothesis* which suggests that improved mental health and wellbeing is the result of increased aerobic capacity derived from enough aerobic physical activity to provide cardiovascular benefits (Crews, Lochbaum, & Landers, 2004). However, studies have shown that anaerobic physical activity, which does not necessarily increase aerobic capacity, can be just as beneficial as aerobic activity in terms of depression and anxiety (Dooyne et al., 1987; Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991). Alternatively, the *endorphins hypothesis* explains that physical activity releases endorphins that improve mood post exercise (Paluska & Schwenk, 2000; Peluso & Andrade, 2005). Studies confirm that physical activity is associated with the release of endorphins; but there has been no confirmation that this

leads to improved mood or longer-term mental health benefits (Paluska & Schwenk, 2000). Finally, the *monoamine hypothesis* suggests that physical activity transmits monoamines such as serotonin, which have an antidepressant effect. However, the monoamine hypothesis has been criticised for oversimplifying the effect of physical activity on mental health (Peluso & Andrade, 2005). In sum, it seems implausible that any physiological explanation is solely responsible for the effect of physical activity on mental health (Paluska & Schwenk, 2000).

A number of environmental explanations have also been discussed. Thompson-Coon et al. (2011) conducted a systematic review and concluded that walking and running outdoors were associated with larger decreases in depression and anxiety, compared to walking and running indoors. Evidence also suggests that increased exposure to *green space* is associated with reduced psychological distress among participants that are frequently active (Astell-Burt, Feng, & Kolt, 2013). Furthermore, the colour green itself has also been associated with lower mood disturbances than other colours (Barton & Pretty, 2010) and may sometimes be an important factor in the relationship with physical activity and mental health.

Lastly, psychological explanations have also been suggested in the literature and offer alternative mechanisms as to why there is a relationship between physical activity and mental health. The *distraction hypothesis* suggests that physical activity distracts individuals from stressful events and is, therefore, responsible for improved mental wellbeing (Leith, 2010). While it is proposed that distraction accounts for some of the antidepressant effect of acute exercise, limited evidence suggests that this hypothesis explains the relationship between habitual physical activity participation and longer term mental wellbeing (Paluska & Schwenk, 2000). The *self-efficacy hypothesis* suggests that physical activity enhances self-efficacy and may therefore produce an

antidepressant effect (Craft & Perna, 2004). Similarly, the *mastery hypothesis* suggests that physical activity exposes individuals to challenges and provides opportunities to develop independence, confidence, and mastery of skills (Paluska & Schwenk, 2000). The benefit to mental health occurs when individuals carry feelings of control and success into other areas of their lives (Paluska & Schwenk, 2000). Lastly, the *social-interaction hypothesis* suggests that the presence or absence of social interaction during physical activity may influence the mental health outcome experienced. The reason that social interaction is deemed important is that social interactions are associated with an increased sense of belonging and a broader support network, which are likely to be responsible for improvements in mental health (Bailey & McLaren, 2005). Teychenne, Ball, and Salmon (2010) supported this notion by finding that those who participated in one quarter of their weekly physical activity with another person experienced less depression (OR = 0.69) than individuals who participated in all physical activity alone (OR = 1.00).

As some evidence exists to support each psychological hypothesis – and, indeed, several other hypotheses reviewed above – it is likely that a number of mechanisms explain the relationship between physical activity and mental health.

Dose-response relationship. Despite ample evidence supporting a relationship between physical activity and mental health, the strength of the relationship varies considerably across studies. This inconsistency needs to be understood so that physical activity can be optimally used to promote mental health. In attempt to understand such inconsistency, much effort has been focused on examining a potential dose-response relationship. With regards to the amount of physical activity required, several reviews have concluded that larger amounts of physical activity are associated with greater mental health benefits for adolescents (Janssen & LeBlanc, 2010) and adults (Janssen &

LeBlanc, 2010; Paluska & Schwenk, 2000; Teychenne, Ball, & Salmon, 2008b).

However, a number of studies have reported that moderate amounts of physical activity are more beneficial than larger amounts (Haarasilta, Marttunen, Kaprio, & Aro, 2004; Tao et al., 2007). Based on such inconsistent findings, it appears that the amount of physical activity is not necessarily important to the relationship between physical activity and mental health. However, it is also plausible that different physical activity measures are responsible for the inconsistent findings.

In terms of intensity, Teychenne et al. (2008b) concluded that among women, vigorous physical activity generally had a stronger association with decreased depression than lower intensity physical activity. On the other hand, Janssen and LeBlanc (2010) reported that moderate physical activity among adolescents was just as strongly associated with reduced depression as vigorous intensity physical activity. Furthermore, in terms of reducing anxiety, Biddle (2000) reported that moderate intensity physical activity was more effective ($d = 1.06$) than higher intensity physical activity ($d = .41$). These findings suggest that a physiological mechanism may not be solely responsible for the relationship between physical activity and mental health, as a relationship appears to be present in numerous studies despite the level of energy expenditure.

In conclusion, findings regarding the optimal duration, frequency, and intensity of physical activity for mental health benefits are inconsistent. Hence, effective promotion of mental health through physical activity remains difficult if the focus is on how much and how often (Paluska & Schwenk, 2000). Research has, therefore, begun to look for other aspects of the physical activity experience which may influence the effect on mental health.

Physical Activity Domains

Physical activity refers to a broad range of bodily movements (Shephard, 2003). Understandably then, current physical activity guidelines encourage individuals to be active in many different ways: during leisure-time, at school or work, as a form of transportation, at home, and through organised sports (Department of Health and Ageing, 2014). While all of these physical activity behaviours can contribute to meeting recommended levels of moderate-to-vigorous physical activity to achieve health benefits (Department of Health and Ageing, 2014), little is known about the relationship between mental health and physical activity within each area of life. Nevertheless, a number of studies have begun to investigate the relationship between mental health and the specific domains (i.e., areas of life) in which physical activity occurs.

A review by Teychenne et al. (2008b) generally showed that leisure-time physical activity appeared to have a stronger inverse relationship with depression compared to total physical activity, or to physical activity not undertaken during leisure-time. Teychenne et al. (2008b) concluded, however, that further studies are required to determine which physical activity domain is optimal, as there was a lack of evidence investigating domains other than leisure-time. More recently, Teychenne et al. (2010) showed that women in the highest tertile of leisure-time physical activity had a lower likelihood of experiencing depression (OR = 0.65) compared to those in the highest tertile of work-related (OR = 0.95), transport (OR = 0.82), or household physical activity (OR = 0.96). Additionally, other studies (Cerin, Leslie, Sugiyama, & Owen, 2009; Jurakić, Pedišić, & Greblo, 2010) have shown that leisure-time physical activity was positively associated with mental health and wellbeing, while work, transport, and household-related physical activity were not.

While good evidence shows that leisure-time physical activity is beneficial for mental health, evidence in other domains appears contradictory. A number of studies have reported no relationship between work-related physical activity and mental health, however, there is some evidence that suggests that physical activity during work may be harmful to mental health. For example, Kull, Ainsaar, Kiive, and Raudsepp (2012) found a positive linear association between work-related physical activity and depression. With regards to active travel, Asztalos et al. (2009) found that biking to work was associated with increased stress for blue collar workers (OR = 1.95), but was not associated with stress for white collar workers (OR = 0.98). Further, Teychenne et al. (2010) found that walking to work was significantly associated with a reduced risk of depression (OR = 0.82, $p = .03$), while cycling to work was not (OR = 0.76, $p = .17$). As such, evidence appears rather contradictory for physical activity domains other than leisure-time. Nevertheless, empirical evidence so far seems to suggest that physical activity accumulated in one domain may not necessarily have the same impact on mental health as physical activity in another domain. Understanding which physical activity domains have stronger positive relationships with mental health, and why, is important so that interventions, policies, and physical activity guidelines can be tailored to better promote mental health and prevent mental ill-health.

Self-Determination Theory

In addition to evidence showing that leisure-time physical activity appears to be the most beneficial domain for promoting mental health, it has been suggested that leisure-time physical activity may be a more self-determined behaviour (i.e., when motivation emanates from within the self) compared to physical activity in other domains (Asztalos et al., 2009; Ryan & Deci, 2000a). As such, Asztalos et al. (2009) and Kull et al. (2012) have proposed that physical activity may have a stronger positive relationship with mental health when individuals' motivation towards physical activity

is self-determined as opposed to non self-determined. Self-determination theory supports such a hypothesis as it explains that the extent to which motivation is self-determined influences the effect of a behaviour on mental wellbeing (Deci & Ryan, 2008a). However, it has not been identified whether this higher-quality motivation explains why leisure-time physical activity holds a stronger relationship with mental wellbeing (Asztalos et al., 2009; Kull et al., 2012). Nevertheless, physical activity during leisure-time is often a chosen activity (Kull et al., 2012), and laboratory studies show that physical activity that includes choice is associated with higher positive affect compared to physical activity not involving choice (Rose & Parfitt, 2007a).

In contrast to leisure-time physical activity, physical activity at work is more likely to be viewed as an obligatory task and, therefore, motivation may be more controlled and less self-determined (Asztalos et al., 2009). This difference in the quality of motivation may explain why leisure-time physical activity has a positive relationship with mental health and work-related physical activity does not. However, little is known about people's motivation towards other physical activity domains such as active travel. Active travel may or may not involve an element of choice, depending on an individual's circumstances; so motivation could be self-determined or non self-determined. Adults with blue collar jobs may not choose to participate in active travel, but cycle to work because they cannot afford more expensive options, like travelling by car (Asztalos et al., 2009). Their participation is, therefore, likely to be non self-determined, and could explain why active travel is positively associated with stress for these individuals (Asztalos et al., 2009). Alternatively, adults with white collar occupations may be able to afford transport by another mode, but choose active travel because of enjoyment or perceived benefits (Asztalos et al., 2009). Hence, their participation would likely be self-determined, and according to self-determination theory, this would benefit their mental wellbeing. It is reasonable then to propose that

differences in the quality of motivation could also be responsible for variation within specific physical activity domains, such as active travel. As such, adopting a self-determination theory framework could be useful for understanding whether higher quality motivation towards physical activity leads to more positive mental health outcomes (Asztalos et al., 2009; Kull et al., 2012).

According to self-determination theory, motivation can be expressed on a continuum of relative autonomy. At one end of the self-determination theory continuum lies self-determined motivation. Emanating from within the self, self-determined motivation is associated with activities where individuals personally choose to participate (Ryan & Deci, 2000a). At the opposing end lies non self-determined motivation. Non self-determined motivation is defined as either a lack of motivation, or motivation that originates from an external incentive or from another person (Ryan & Deci, 2000a). Self-determination theory further classifies human motivation into a number of smaller categories based on the degree of relative autonomy (see Figure 1).

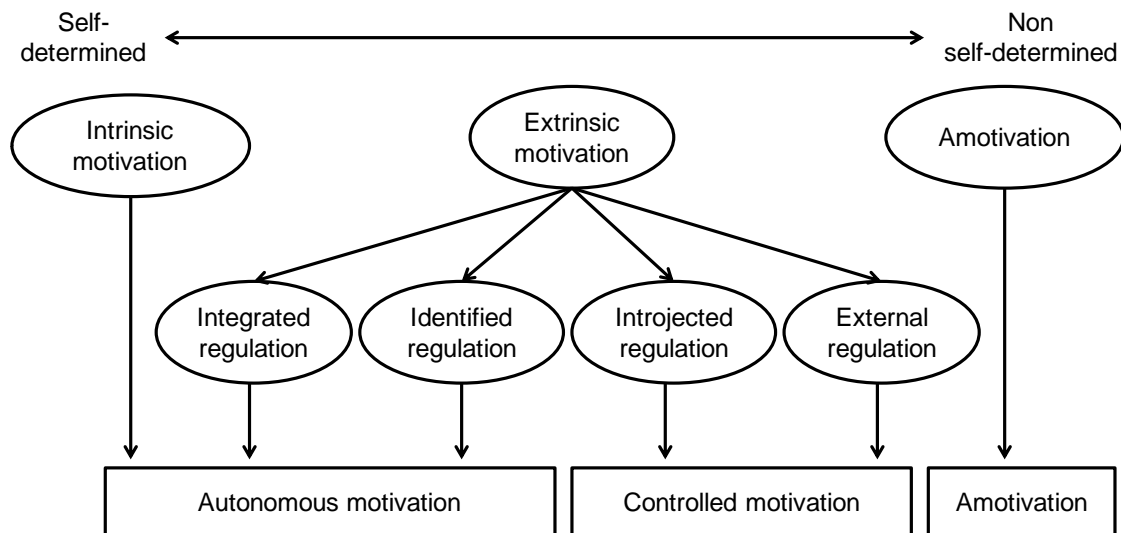


Figure 1. The taxonomy of human motivation, adapted from Ryan & Deci (2000).

Intrinsic motivation refers to participating in an activity due to its inherent satisfaction, and is therefore, the most-self determined form of motivation (Ryan &

Deci, 2000a). *Extrinsic motivation* is defined as participating in an activity to attain a separable outcome and is, therefore, less self-determined (Ryan & Deci, 2000a). Within self-determination theory lie a number of sub-theories. Organismic integration theory concerns extrinsic motivation and identifies factors that either promote or hinder the internalisation of extrinsic motivation (Ryan & Deci, 2000b). The more an individual internalises extrinsic motivation, the more self-determined they are. Within organismic integration theory, extrinsic motivation is further classified into four types of motivation which vary in terms of their level of self-determination (Ryan & Deci, 2000a).

Individuals who participate in physical activity because they personally value the benefits (i.e., identified regulation) or because the value of physical activity has been entirely endorsed as essential to their sense of self (i.e., integrated regulation), are more self-determined than people who participate to avoid punishment (i.e., external regulation) or guilt (i.e., introjected regulation; Ryan & Deci, 2000a). Therefore, intrinsic motivation, integrated regulation, and identified regulation, are classified as *autonomous motivation* (Ryan & Deci, 2000a).

Introjected regulation (i.e., participating in an activity to avoid guilt or experience pride) is more self-determined than *external regulation* (i.e., participating to avoid punishment or obtain an external reward); however, both regulations are *controlled* in nature because motivation is based on obtaining an outcome which is separable from the activity itself (Ryan & Deci, 2000a). Individuals, however, don't like to feel controlled by other people because it undermines their self-determination (Biddle & Mutrie, 2015). As such, behaviours undertaken due to controlled motivation often encompass stress and pressure which are likely to undermine any psychological benefit that might arise if no control were present (Vansteenkiste, Lens, De Witte, De Witte, & Deci, 2004). According to organismic integration theory, interest, enjoyment, inherent satisfaction, and personal importance cause individuals to internalise extrinsic

motivation, while compliance, punishments, external rewards, and a perceived lack of control do not (Deci & Ryan, 2002a).

At the far right of the continuum is *amotivation*, representing a complete lack of intention to act (Ryan & Deci, 2000a). Amotivation is often present due to not valuing the activity (Ryan, 1995), not feeling competent in the activity (Deci, 1975), or not believing that participation in the activity will yield any desirable outcome (Seligman, 1975). Amotivation towards an activity means motivation is completely non self-determined.

Within self-determination theory, also lays basic psychological needs theory. This sub-theory asserts that humans have three basic psychological needs which must be met in order to experience positive psychological wellbeing; they are autonomy, competence, and relatedness (Ryan & Deci, 2006). Some interpersonal environments obligate individuals towards a certain behaviour, while other interpersonal environments provide flexibility in decision making to choose between options (Reeve, Nix, & Hamm, 2003). When individuals feel as though they have a choice, they are more likely to feel autonomous in their decision to participate in a behaviour, regardless of the number of actual choices available (Ryan & Deci, 2006). Therefore, when individuals feel as though their participation in an activity is chosen freely and it is in accordance with their own self, experience a sense of competence, and have their need to feel connected with others fulfilled, optimal mental wellbeing is a more likely outcome (Deci & Ryan, 2002a).

In conclusion, evidence suggests that increased leisure-time physical activity is associated with increased mental health more strongly than physical activity in other domains. Asztalos et al. (2009) and Kull et al. (2012) suggested that differences in motivation may explain why the relationship between physical activity and mental

health differs between physical activity domains. This notion is consistent with self-determination theory as Deci and Ryan (2002a) explain that autonomously motivated behaviours are expected to lead to positive mental wellbeing, while behaviours undertaken for controlled reasons are likely to be detrimental to mental wellbeing. However, this hypothesis has not been tested empirically. As such, this thesis seeks to understand the role of autonomous motivation, controlled motivation, and amotivation in the relationships between domain-specific physical activity and mental health.

Gaps in the Literature

Although a number of studies have examined physical activity within specific physical activity domains, evidence remains limited for domains other than leisure-time. Furthermore, there has been no synthesis of the literature in order to understand which physical activity domain is optimal for promoting mental health. Also, depression has been measured as an outcome of domain-specific physical activity far more than any other mental health variable. Although depression accounts for 41% of the disability caused by mental health disorders (Whiteford et al., 2013), mental health is not merely the absence of mental ill-health, and positive mental health variables need to be explored more extensively. Few studies have investigated the relationship between domain-specific physical activity and mental health in children or adolescents. Given that mental health disorders often arise during adolescence, and are the leading contributor to burden of disease in people younger than 25 years (Begg et al., 2007; Kessler et al., 2005), research should more extensively examine these relationships in young people. Finally, no study has investigated whether self-determined motivation moderates the relationships between domain-specific physical activity and mental health.

Overview of Thesis

Thesis Aim

The two main aims of this thesis were to investigate the relationships between domain-specific physical activity and mental health, and explore the influence of self-determined motivation on these relationships. The overarching objective was to understand which physical activity domains have stronger positive relationships with mental health, and why, to inform future physical activity guidelines and policy development so that physical activity can better promote mental health and prevent mental ill-health. To achieve this objective, four studies were carried out and a number of specific research objectives were met.

Specific Research Objectives

Study 1

1. Systematically review evidence from studies that have investigated relationships between mental health and physical activity during specific life domains.
2. Provide meta-analytic evidence of the relationships between physical activity and mental health within specific physical activity domains.
3. Compare the strength of relationships between mental health and physical activity accumulated in different domains to identify the domains most likely to benefit mental health.
4. Identify gaps in the current literature regarding the relationship between domain-specific physical activity and mental health, particularly with regard to adolescents.

Study 2

1. Qualitatively investigate adolescents' experiences of physical activity in different life domains.

2. Examine the perceived influence of physical activity on moods, emotions, and affective states when physical activity is undertaken by adolescents in different life domains.
3. Determine whether adolescents perceive the relationship between physical activity and affect to be influenced by self-determined motivation.

Study 3

1. Develop the Motivation towards Active Travel to School Scale (MATSS) to measure adolescents' autonomous motivation, controlled motivation, and amotivation towards active travel to and from school.
2. Evaluate the psychometric properties of the MATSS among adolescents.

Study 4

1. Identify the relationships between leisure-time physical activity and positive and negative affect among adolescents.
2. Identify the relationships between active travel and positive and negative affect among adolescents.
3. Compare the strength of relationships between leisure-time physical activity and affect with relationships between active travel and affect among adolescents.
4. Examine whether motivation towards physical activity moderates the relationships between domain-specific physical activity (i.e., leisure-time and active travel) and positive and negative affect among adolescents.

Significance of the Thesis

Abundant evidence shows that physical activity has a positive association with mental health. Given that many mental health disorders begin in adolescence, physical activity should be used to promote mental health and prevent mental ill-health among youth. However, evidence suggests that not all physical activity experiences bring about

the same psychological benefit. This thesis seeks to identify the physical activity domains that are most beneficial to mental health and the role that motivation may play in these relationships. Understanding which physical activity domains have stronger positive relationships with mental health, and whether autonomous motivation can improve the relationships between domain-specific physical activity and mental health, could lead to more tailored interventions, policies, and physical activity guidelines with an increased potential to improve mental health and prevent mental ill-health

Outline of Thesis Chapters

Chapter 1 has introduced the topic of this PhD research within the broader field, discussed the relevant literature, and stated the aims, objectives, and significance of this thesis.

Chapter 2 presents a systematic review and meta-analysis of studies that examine the relationship between physical activity and either mental health or mental ill-health in one or more physical activity domain. Specific methods are explained, results discussed, and gaps within the literature identified.

Chapter 3 presents a qualitative study on adolescents' perceptions regarding physical activity in different domains and affective wellbeing. Findings are discussed in relation to the perceived influence of physical activity on positive and negative affect in different domains, and the perceived role of self-determined motivation.

Chapter 4 outlines the methodological processes involved in developing the Motivation towards Active Travel to School Scale (MATSS) and reports the psychometric properties of the MATSS.

Chapter 5 presents the results of a study measuring physical activity in two specific physical activity domains (i.e., leisure-time and active travel), self-determined

motivation towards physical activity in each specific domain, and positive and negative affect. It seeks to determine whether motivation moderates the relationships between domain-specific physical activity and affective wellbeing.

Chapter 6 synthesises the results of the four studies conducted for this thesis, and draws conclusions regarding the importance of physical activity domain and the role of self-determined motivation in terms of the relationship with mental health. The chapter also considers limitations and suggests areas for important future research.

Synopsis

This chapter has highlighted the importance of mental health in adolescence, and has discussed the relationship that exists between physical activity and mental health. Chapter 1 has also drawn light to the fact that the domain in which physical activity occurs may be important to the relationship between physical activity and mental health, and that different levels of self-determined motivation may also be influential. Finally, Chapter 1 concluded with an overview of this thesis. Chapter 2 will build upon this premise by systematically reviewing studies that have measured the relationship between physical activity and a number of mental health and mental ill-health variables within specific domains. This will lead to meta-analytic evidence suggesting which physical activity domains are optimal for promoting mental health and preventing mental ill-health.

CHAPTER 2: Meta-Analysis

Domain-specific physical activity and mental health: Systematic review and meta-analyses

Abstract

Context: The mental health benefits of physical activity are well established. However, less is known about whether physical activity during some life domains is more beneficial for mental health than physical activity in other life domains. It is important to understand how context may impact the relationship between physical activity and mental health so that interventions and policy guidelines can be tailored to maximise positive effects.

Evidence acquisition: Systematic searches of four databases identified 13,435 records, of which 98 studies met the inclusion criteria.

Evidence synthesis: Included studies were published between 1988 and 2015 and had a combined sample size of 648,726. Of the 98 studies included, 93 examined leisure-time physical activity, 14 examined work-related physical activity, 15 examined transport physical activity, 16 examined household physical activity, three examined school sport, and three examined physical education. Multi-level meta-analyses showed that leisure-time physical activity ($r = .13$) and transport physical activity ($r = .13$) both have a positive association with mental health. Leisure-time physical activity ($r = -.11$) and school sport ($r = -.09$) both have an inverse association with mental ill-health. However, physical activity is not universally associated with mental health across different domains as work-related physical activity is positively associated with mental ill-health ($r = .09$). Household physical activity and participation in physical education had no relationship with mental health or mental ill-health.

Conclusions: The domain in which physical activity occurs influences the relationship between physical activity and mental health and should, therefore, be considered when developing interventions, treatment programs, and policy guidelines.

Context

Mental ill-health is responsible for a large portion of the burden of disease worldwide (Begg et al., 2007; M. Prince et al., 2007; Whiteford et al., 2013). Individuals with mental ill-health may experience low self-esteem, struggle to maintain interpersonal relationships, and have a higher risk of communicable and non-communicable diseases than those not experiencing mental ill-health (M. Prince et al., 2007; World Health Organization, 2001). Mental health, however, is a positive state of wellbeing where individuals realise their potential, experience positive emotions, and are able to cope with stress, maintain interpersonal relationships, work productively, and contribute to their community (Herrman et al., 2005).

Systematic reviews have shown that physical activity is associated with greater mental health (Bize et al., 2007), and a reduced risk of mental ill-health, more specifically depression and anxiety (Biddle & Asare, 2011; Janssen & LeBlanc, 2010). Interestingly however, many of the studies included in these reviews measured total weekly physical activity. Given that physical activity is defined as any muscular movement that uses energy, physical activity can take place during a variety of life domains (Shephard, 2003). While leisure-time is the most studied physical activity domain (i.e., area of life which presents opportunities for physical activity), physical activity can also take place at work or school, as a method of transportation, or while carrying out household chores. Given that the reasons for participation in physical activity are likely to differ between physical activity domains, it is possible that the

outcomes experienced also vary (Pratt, Macera, Sallis, O'Donnell, & Frank, 2004; Sallis et al., 2006).

A literature review that compared total physical activity (i.e., all physical activity undertaken in a given time regardless of life domain) to leisure-time physical activity reported that leisure-time physical activity was more consistently and strongly associated with reduced depression (Teychenne et al., 2008b). This finding suggests that the domain in which physical activity is undertaken is an important factor in the physical activity and mental health relationship. A number of individual studies have also shown that leisure-time physical activity has a stronger association with mental health and mental ill-health, compared to work-related physical activity, transport physical activity, and household physical activity (Asztalos et al., 2009; Kull et al., 2012; Ohta, Mizoue, Nishima, & Ikeda, 2007). In order to optimally use physical activity to promote mental health and prevent mental ill-health, an understanding of mental health benefits within specific physical activity domains is required. The primary purpose of this study was to synthesise study results and provide meta-analytic evidence of the relationships between domain-specific physical activity and mental health and mental ill-health. The secondary purpose was to conduct a series of moderated meta-analyses to explore factors which may contribute to variation in these relationships. The final purpose was to identify gaps in the literature regarding physical activity domains that have not been investigated extensively.

Evidence Acquisition

The methods detailed below were conducted in accordance with the 'Preferred Reporting Items for Systematic Reviews and Meta-Analysis' (PRISMA) statement (Moher, Liberati, Tetzlaff, & Altman, 2009). Further details regarding the methods are presented in Appendix A.

Inclusion Criteria

Studies eligible for this review met the following inclusion criteria: (a) a quantitative assessment of physical activity within at least one specified domain (e.g., leisure-time, work, physical education, active travel, or household or domestic duties), unless an experimental study was carried out within a specific domain then no domain-specific measure of physical activity was required, (b) a quantitative assessment of at least one mental health outcome variable (i.e., mental health, mental wellbeing, psychological wellbeing, subjective wellbeing, life satisfaction, positive affect, negative affect, depression, anxiety, stress, or psychological distress), (c) a quantitative assessment of the relationship between physical activity in a specified domain and mental health, (d) a cross sectional, longitudinal, or experimental design, and (e) full text, peer reviewed journal articles.

With regards to the mental health related search terms, all studies measuring mental health, mental wellbeing, and psychological wellbeing were included (Cattan, 2009). Further, positive affect and life satisfaction are two core components of mental wellbeing and were also included (Luhmann et al., 2012). Mental ill-health is defined as a broad term encompassing mental health disorders and preclinical mental health problems (Barry & Jenkins, 2007; Fontaine, 2009; D. R. Lubans et al., 2016; World Health Organization, 2004). Internalising disorders are the largest cluster of mental disorders within the DSM-V and are responsible for a large portion of the burden of disease attributable to mental ill-health (Goldberg, Krueger, Andrews, & Hobbs, 2009; McLoone & Hudson, 2006; Tut, Wang, & Lim, 2000; Whiteford et al., 2013). Internalising disorders reflect the tendency to express mental distress inwards emotionally, and include unipolar depression and anxiety disorders (Goldberg et al., 2009; Krueger, McGue, & Iacono, 2001). As such, mental ill-health in this review refers

to symptoms of internalising mental disorders (i.e., depression and anxiety) and mental health problems (i.e., psychological distress, stress, negative affect).

Exclusion Criteria

Studies were excluded if they: (a) included participants from special populations (e.g., participants who were physically frail), (b) only measured total physical activity or did not specify the domain in which physical activity was measured, (c) measured sedentary behaviour but not levels of physical activity, (d) measured mental health specifically in terms of a particular setting or circumstance (e.g., job strain), (e) solely reported qualitative data, or (f) were published in languages other than English. In efforts to include evidence published in languages other than English, Google Translate was tested for accuracy. However, a number of key words (e.g., wellbeing) were incorrectly translated to English and it was therefore, not suitable to include non-English manuscripts.

No exclusion criterion based on age was included in the searches. While adolescents are the target population for the remainder of this thesis, it was expected based on initial searches, that very few studies measuring domain-specific physical activity and a mental health related outcomes have recruited adolescents. As such, this chapter draws together a large amount of evidence from participants of any age to draw a comprehensive picture of the relationship between physical activity in mental health across a number of domains, and tests for age as a moderator.

Search Strategy

Systematic searches were conducted in February 2015 in four databases: Scopus, PubMed, PsychINFO, and SPORTDiscus. Searches involved keywords from three main groups, including physical activity terms (physical activit*, physical inactivity, exercise, sport, and walking), mental health-related terms (mental health, mental well*being,

psychological well*being, subjective well*being, positive affect, negative affect, life satisfaction, mental illness, mental disorder*, depress*, anxiety, stress, and psychological distress), and domain-specific terms (commut*, leisure time, types of, domain*, work, occupation*, travel, housework, household, sport*, transport*, cycling, domestic, work-related, transport-related, pe, p.e., and physical education). The search was not restricted by publication date or study design, but did include exclusion terms to reduce the number of irrelevant records identified. The full search strategy including exclusion terms can be found in Table B1 (see Appendix B). Search results were exported into Endnote reference manager software and duplicates were removed. When the University library could not locate a study, the lead author was contacted. If the lead author did not respond and the article could not be obtained it was excluded.

Study Selection

Two reviewers independently assessed the title and abstract of each study. A record was only excluded if it was recommended for exclusion by both reviewers. The same two reviewers then independently screened the full text of the remaining studies – recommending each for inclusion or exclusion. If a study was recommended for exclusion, the specific inclusion criterion that was not fulfilled was noted. Discussion between the two reviewers and a third researcher resolved all discrepancies. Finally, the reference lists of all included studies were checked for any relevant articles not returned in the search results.

Data Extraction

The candidate extracted data from each article into a predefined data extraction form. Data items included: authors, year of publication, study design, sample (size, age, sex, and country), measures of physical activity, measures of mental health or mental ill-health, method of data analysis, statistical results, and written findings. A second

reviewer cross-checked the extracted data for accuracy and any discrepancies were discussed and resolved.

Statistical Analysis

Effect sizes. Correlation effect sizes (r) were either extracted, or calculated from the results of each individual study (Borenstein, Hedges, Higgins, & Rothstein, 2009; Rosenthal, 1991). Next, each correlation coefficient was corrected for attenuation, which is the underestimation of a population effect size due to instruments failing to measure the participants' true scores (Hunter & Schmidt, 2004). Corrections were based on the internal consistency scores (e.g., Cronbach's α) of the physical activity measure and mental health measure (Charles, 2005; Hunter & Schmidt, 2004). When this information was missing in a study, an internal consistency score reported in similar literature for the same measure was used. If an internal consistency score was not obtainable, or the study used a single item measure, $\alpha = .70$ was used. This is not because $\alpha = .70$ is advocated as a specific acceptable cut-off, but as a conservative estimate of reliability for studies where the exact score could not be obtained (J. Cohen, Cohen, West, & Aiken, 2013; Nunnally, 1978). Finally, because r becomes more skewed as the value moves further away from zero, all correlations were converted to Fisher's adjusted Z scale (z), which is almost normally distributed (Borenstein et al., 2009; Rosenthal, 1991). Finally, the variance (v) and standard error (SE) were calculated (Borenstein et al., 2009).

Random effects multilevel model. First, two random effects meta-analyses were conducted (i.e., one for mental health and one for mental ill-health). In order to account for dependent effect sizes, three-level meta-analyses were employed, where level 2 refers to multiple effect sizes within studies and level 3 refers to studies (M. W. L. Cheung, 2015a). The metaSEM package (M. W. L. Cheung, 2015b) was used to

conduct all meta-analyses using structural equation modelling in R (version 3.2.2; R Core Team, 2016), and the weighted average effect sizes (r) and 95% CIs were reported for each meta-analysis. If the CI did not include zero, then the effect size was statistically significant at the conventional level (i.e., $p < .05$). In line with Cohen's (1977) guideline for interpreting correlations, a correlation of .10 was interpreted as weak, .30 moderate, and .50 strong.

Assessing heterogeneity. The I^2 statistic indicates the percentage of the total variation in effect sizes that is due to genuine differences between the individual study results as opposed to chance (Higgins, Thompson, Deeks, & Altman, 2003). Given that the I^2 statistic increases rapidly towards 100% as the number of participants within the primary studies increases (i.e., reduced within study variance), the I^2 should be interpreted as an indication of possible heterogeneity that may be relevant (Rücker, Schwarzer, Carpenter, & Schumacher, 2008). According to Cochrane's overlapping criteria, an I^2 statistic between 0% and 40 % may not be important, 30% to 60% is likely to indicate moderate heterogeneity, 50% to 90% suggests substantial heterogeneity, and >75% considerable heterogeneity (Higgins & Green, 2008).

Moderator analyses: Mixed effects multilevel models. Next, a series of subgroup analyses were conducted, reporting the effect size and 95% CI within each subgroup, as well as mixed-effects meta-analyses which included potential moderator variables. For each mixed-effects meta-analysis, the regression coefficient (β) which shows whether the moderator was a positive or negative predictor of the effect size and the R^2 which demonstrates the proportion of heterogeneity that can be explained by the moderator variable were reported (M. W. L. Cheung, 2015a). The p value for an omnibus ANOVA test demonstrating whether the mixed effects model including the moderator was significantly different from the original random-effects model was also

reported. Variables that were tested as a moderator included: physical activity domain, the specific mental health outcomes, age, sex, study design, and risk of bias. Age was categorised as children (1-9 years), adolescents (10-19 years), adults (20-64 years), and older adults (65+ years) (Doherty et al., 1994; World Health Organization, 2012).

Publication bias. Rosenthal's (1979) fail-safe N was utilised to indicate the number of unpublished studies with a mean effect of zero that would be required to cause a significant meta-analysis effect to become non significant ($p > .05$). A larger fail-safe N , relative to the number of included studies, suggests that unpublished studies not included in the review would be unlikely to overturn the effect reported (Rosenthal, 1979).

Risk of Bias of Individual Studies

Given that the Cochrane Collaboration's tool for assessing risk of bias was developed to assess bias typical in intervention studies (Higgins & Green, 2008), it was not appropriate to use the exact Cochrane tool to assess risk of bias in a review in which 98% of studies were observational. Instead, six criterion were adapted from the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (Von Elm et al., 2007) and the Consolidated Standards of Reporting Trials (CONSORT) statement to assess risk of bias of individual studies (Moher, Schulz, & Altman, 2001). The criteria used was similar to that used in previous meta-analyses (Babic et al., 2014; Owen et al., 2016). Two reviewers independently assigned a 1 (present and explicitly explained) or a 0 (absent or inadequately described) to each included study on each criterion: a) random selection of schools/and or participants (sampling procedures were appropriate and adequately described, including randomisation process for experimental studies), b) participant eligibility criteria stated and adequate description of study sample, c) valid assessment of physical activity

participation including adherence to a physical activity program if no direct measure of physical activity was included, d) valid assessment of mental health or mental ill-health, e) covariates adjusted for in analyses relating to physical activity and mental health (e.g., sex and age), f) power calculation reported and the study was adequately powered to detect hypothesised relationships. Next, percentage agreement and Cohen's kappa coefficient (J. Cohen, 1968) were calculated and discrepancies were discussed until reaching 100% agreement.

While all measures of physical activity include measurement error (Welk, 2002), abundant evidence shows that self-report measures lead to bias due to social desirability and difficulty recalling previous physical activity participation (Sallis & Saelens, 2000). However, self-report measures encompass varying degrees of measurement error, and testing a scale or instrument for reliability and validity can demonstrate that a measure is likely to include an acceptable amount of error (Hunter & Schmidt, 2004). Therefore, a valid assessment of physical activity in this systematic review refers to either an objective measure of physical activity (i.e., a direct measure of movement or physical activity related energy expenditure; Sallis & Saelens, 2000) or a self-report measure where validity or reliability of the test scores has been demonstrated.

If information relating to the risk of bias criteria was absent, but cited a protocol paper, the cited protocol was checked for more information. However, authors' were not contacted to ask for missing information required for risk of bias. There were two reasons for this decision. Firstly, when tracking down authors, receiving a response from every author request is unlikely (Mayhew, Kabir, & Ansari, 2015) and if some authors responded (enabling us to change their score from a 0 to a 1) and others did not (score would remain 0), further bias could be introduced as individual study scores would be partially dependent on author responsiveness. Secondly, evidence shows that

contacting individual authors to request information for a review sometimes leads to overly positive answers.(Mayhew et al., 2015) Given these two limitations and that contacting authors regarding risk of bias is not required by the PRISMA statement, articles with missing information were given a 0 for being absent (Liberati et al., 2009).

Evidence Synthesis

Studies Included

As shown in Figure 2, the literature search yielded 13,435 studies. Following title and abstract screening, 373 full-text articles were retrieved and reviewed. Ninety-eight studies met the inclusion criteria and were included in the review. At least one suitable effect size could be calculated for all but one study (Bogaert, De Martelaer, Deforche, Clarys, & Zinzen, 2014).

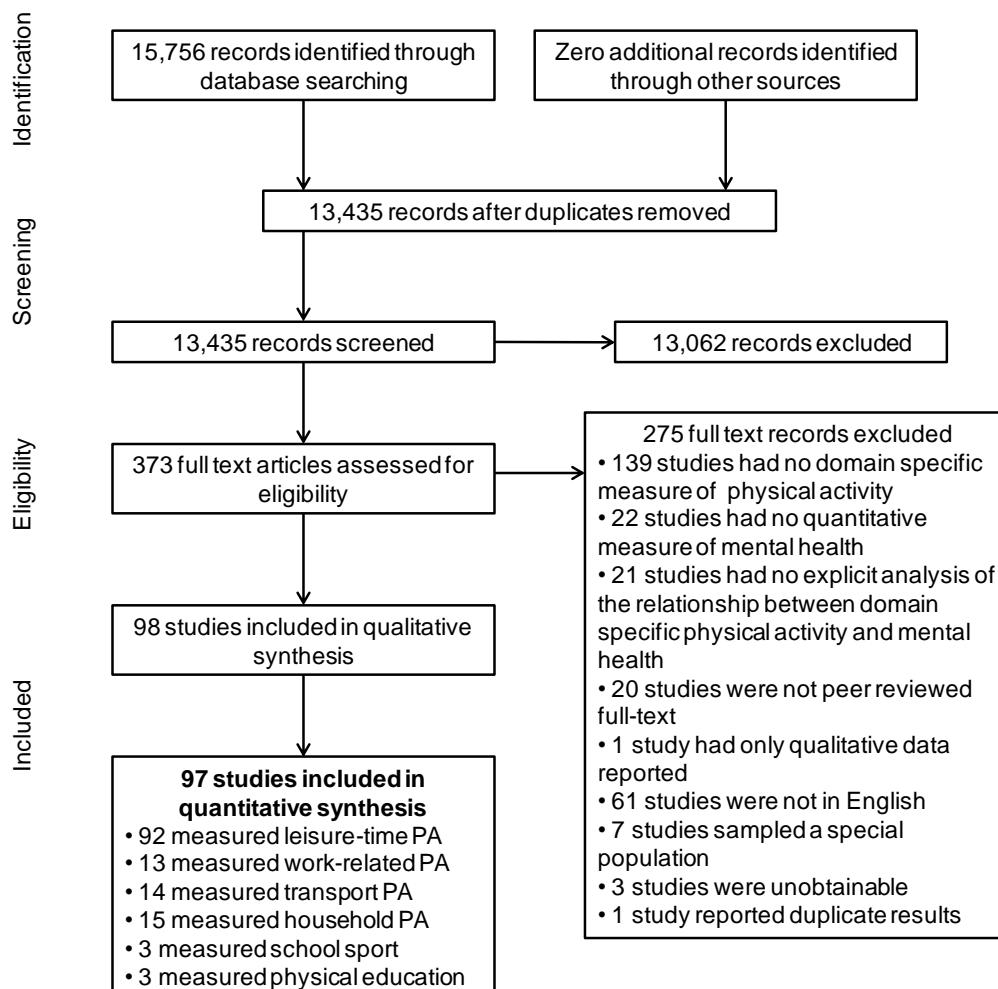


Figure 2. Flow diagram of articles throughout the systematic review.

The majority of studies (76%) sampled adults with far fewer studies providing evidence among youth – 22% recruited adolescents and 1% recruited children. The majority of studies measured leisure-time physical activity (95%), few studies measured physical activity in other life domains – 13% measured work-related physical activity, 14% measured transport-related physical activity, 15% measured household physical activity, 3% measured school sport, and 3% measured physical education. Further, among adolescents there is lack of evidence for work-related physical activity ($k = 1$), transport physical activity ($k = 3$), household physical activity ($k = 1$), school sport ($k = 3$) and physical education ($k = 4$), in comparison to leisure-time ($k = 16$). This demonstrates a large gap in the current literature. Table B3 (see Appendix B) shows the number of studies measuring each mental health variable within each physical activity domain and highlights gaps in the literature according to age.

Risk of Bias Assessment

Initially there was 90% agreement on the risk of bias between the two reviewers and the kappa coefficient ($\kappa = .81$) indicated strong agreement (McHugh, 2012). Upon discussion 100% agreement was achieved. Nineteen percent of studies had a high risk of bias and 59% had a moderate risk of bias, while only 18% had a low risk of bias. The complete risk of bias results are shown in Table B4 (see Appendix B).

Effect Sizes, Heterogeneity, and Moderator Analyses

Figure 3 highlights the effect size and 95% CI for each physical activity domain for both mental health and mental ill-health. The meta-analyses results for each physical activity domain along with moderator variables which explained a considerable proportion of the heterogeneity are discussed below. Full results of the moderated meta-analyses are presented in Table 1 and Table 2.

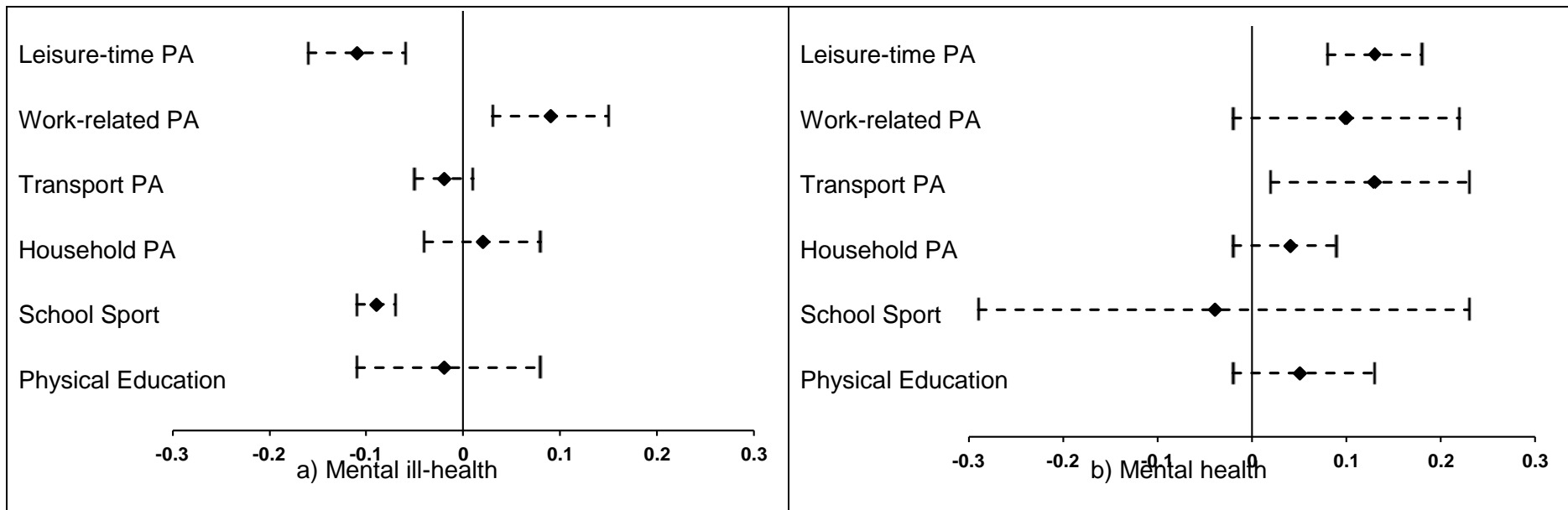


Figure 3. Correlations and 95% CIs within specific physical activity domains for mental health and mental ill-health.

Mental ill-health. Physical activity has a weak negative association with mental ill-health ($r = -.09$, 95% CI = $-.13, -.04$, $p < .001$). Overall, physical activity domain significantly moderates the strength of the relationship between physical activity and mental ill-health ($p < .001$) and explains 46% of the variance. In comparison to leisure-time physical activity, school sport is not significantly different ($\beta = -.04$, $p > .05$), whereas work-related physical activity ($\beta = .19$, $p < .001$), transport physical activity ($\beta = .07$, $p < .05$), household physical activity ($\beta = .11$, $p < .001$), and physical education ($\beta = .07$, $p > .05$) are all positive predictors of the effect size.

Leisure-time physical activity has a weak inverse association with mental ill-health and large heterogeneity is evident. Table 1 shows that the outcome measured is a significant predictor of strength, accounting for 36% of the variance. This is largely because there is a stronger negative association between leisure-time physical activity and depression ($r = -.16$), compared to other mental ill-health measures ($r = -.03$ to $-.09$). While age is not a significant moderator ($p = .08$), the relationship between leisure-time physical activity and mental ill-health is stronger among adults ≥ 65 years of age ($r = -.26$), compared to children ($r = -.12$), adolescents ($r = -.07$), and adults < 65 years ($r = -.09$). School sport is also significantly associated with mental ill-health, however, the effect ($r = -.09$) is slightly smaller than leisure-time ($r = -.11$) and no moderator tested is a significant predictor. In contrast, work-related physical activity has a weak positive association with mental ill-health. Age significantly moderates this relationship ($p = .03$) as the effect is larger among adults ($r = .10$) than adolescents ($r = .01$), but this only explains 13% of the variance. Transport physical activity, household physical activity, and physical education have no significant association with mental ill-health.

Table 1

Domain-Specific Physical Activity and Mental Ill-health Meta-Analyses

	<i>k</i>	# ES	<i>r</i>	95% CI	<i>I</i> ² (%)	Fail- safe <i>N</i>	Predictor coefficient β	ANOVA <i>p</i> value	<i>R</i> ²
Leisure-time PA	70	116	-.11***	-.16, -.06	99.04	7,717			
<u>Outcome</u>								.007	.36
Psychological distress	17	23	-.03	-.10, .04	99.50		n/a		
Perceived stress	10	12	-.09	-.19, .01	98.33		-.06		
Life dissatisfaction	1	1	-.09	-.27, .10	n/a		-.06		
Negative affect	8	13	-.08	-.08, .01	97.03		-.04		
Depression	42	58	-.16***	-.21, -.10	98.51		-.13***		
Anxiety	7	9	-.06	-.15, .02	96.11		-.04		
<u>Age</u>								.08	.11
Children	1	2	-.12	-.05, .26	n/a		-.03		
Adolescents	11	24	-.07	-.19, .05	97.91		.02		
Adults	44	74	-.09**	-.15, -.03	99.23		n/a		
Older adults	10	11	-.26***	-.38, -.14	98.51		-.18*		
<u>Sex</u>								.13	.06
Both	47	74	-.09**	-.15, -.02	99.15		n/a		
Female	15	19	-.06	-.13, .01	97.99		-.12*		
Male	9	13	-.01	-.09, .06	99.25		-.11		
<u>Study design</u>								.34	.00
Cross-sectional	56	87	-.10***	-.15, -.05	99.21		n/a		
Longitudinal	16	28	-.13**	-.22, -.04	97.45		-.03		
Experimental	1	1	-.49	-.83, .10	n/a		-.44		
<u>Risk of bias</u>								.21	.03
Total score /6							-.10		
Work-related PA	9	14	.09**	.03, .15	95.89	79			
<u>Outcome</u>								.13	.28
Psychological distress	1	1	.23**	.07, .37	n/a		n/a		
Depression	8	11	.06*	.01, .10	92.98		-.17*		
Anxiety	1	2	.03	-.10, .15	48.37		-.21*		
<u>Age</u>								.03	.13
Adolescents	1	2	.01	-.15, .17	n/a		-.09		
Adults	8	12	.10	.04, .16	95.89		n/a		
<u>Sex</u>								.55	.15
Both	2	5	.03	-.08, .14	97.46		n/a		
Female	6	6	.10**	.04, .18	91.30		.07		
Male	3	3	.10*	.02, .19	90.22		.07		
<u>Risk of bias</u>								.16	.25
Total score /6							-.41		
Transport-related PA	7	15	-.02	-.05, .01	73.03				
<u>Outcome</u>								.51	.12

Psychological distress	2	5	-.03	-.07, .02	33.05	n/a		
Perceived stress	2	5	-.01	-.06, .03	74.44	.02		
Negative affect	1	2	-.06	-.13, .03	n/a	-.03		
Depression	3	3	-.01	-.06, .04	81.66	.02		
<u>Age</u>							.59	.09
Adolescents	2	4	-.04	-.09, .02	45.76	-.02		
Adults	5	11	-.02	-.05, .02	69.52	n/a		
<u>Sex</u>							.42	.03
Both	3	10	-.04	-.12, .04	76.60	n/a		
Female	4	4	-.00	-.06, .06	76.58	.03		
Male	1	1	-.05	-.20, .10	n/a	-.01		
<u>Purpose of trip</u>							.51	.47
Not specified, or includes all travel	3	3	-.01	-.06, .03	81.66	n/a		
To school	1	2	-.06*	-.11, -.01	n/a	-.05		
To work	2	5	-.01	-.05, .03	50.92	.01		
During leisure-time	3	5	-.03	-.06, .01	55.42	-.01		
<u>Risk of bias</u>							.93	.30
Total score /6						-.04		
Household PA	11	16	.02	-.04, .08	92.75			
<u>Outcome</u>							.05	.08
Psychological distress	2	2	-.06	-.21, .09	92.93	n/a		
Perceived stress	3	4	.01	-.10, .12	80.73	.10		
Depression	8	10	.04	-.04, .12	83.53	.12		
<u>Age</u>							.87	.02
Adolescents	1	2	.00	-.19, .19	n/a	-.01		
Adults	7	10	.02	-.04, .07	94.15	n/a		
Older adults	3	4	.05	-.08, .18	91.12	.04		
<u>Sex</u>							.99	.00
Both	6	9	.02	-.07, .11	94.89	n/a		
Female	5	5	.02	-.07, .12	76.98	.00		
Male	5	5	.02	-.10, .14	88.73	.00		
<u>Risk of bias</u>							.65	.11
Total score /6						-.09		
School sport	2	3	-.09***	-.11, -.07	61.37	26		
<u>Outcome</u>							.12	.00
Perceived stress	1	1	-.14***	-.26, -.01	n/a	n/a		
Depression	2	2	-.06	-.17, .05	63.78	.06		
<u>Study design</u>							.85	.00
Cross-sectional	1	1	-.09	-.23, .05	n/a	n/a		
Longitudinal	1	2	-.09	-.19, .02	n/a	-.09		
<u>Risk of bias</u>							.85	.00
Total score /6						-.01		
Physical education	2	3	-.02	-.11, .08	97.70			
<u>Outcome</u>							.002	1.00

Negative affect	1	2	-.08**	-.14, -.03	n/a	n/a		
Depression	1	1	.05	-.09, .19	n/a	.14		
<u>Risk of bias</u>							.002	1.00
Total score /6						.72		

Note. Boldface indicates statistical significance. Fail-safe N is only included for meta-analysis effects that are significant. β = standardised regression coefficient; ES = effect sizes; $I^2 = I^2$ statistic indicating proportion of variation due to heterogeneity; k = number of studies; PA = physical activity; r = correlation effect size; R^2 = proportion of heterogeneity that can be explained by the moderator variable.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Mental health. Overall, physical activity in the included studies has a weak positive association with mental health ($r = .11$, 95% CI = .07 to .17, $p < .001$). Physical activity domain is not a significant moderator of the relationship between physical activity and mental health ($p = .59$), as work-related physical activity ($\beta = -.03$), transport physical activity ($\beta = .01$), household physical activity ($\beta = -.03$), school sport ($\beta = -.03$), and physical education ($\beta = -.03$) are all non-significant negative predictor coefficients, compared to leisure-time. Nevertheless, the effect sizes vary between domains, and only two domains are significantly associated with mental health.

Table 2

Domain-Specific Physical Activity and Mental Health Meta-Analyses

	<i>k</i>	# ES	<i>r</i>	95% CI	<i>I</i> ² (%)	Fail-safe <i>N</i>	Predictor coefficient β	ANOVA <i>p</i> value	<i>R</i> ²
Leisure-time PA	33	58	.13***	.08, .18	99.59	1, 931			
<u>Outcome</u>								.46	.16
Mental health	12	19	.14**	.05, .22	98.70		n/a		
Mental wellbeing	6	10	.20**	.05, .34	97.30		.07		
Life satisfaction	12	15	.15***	.10, .21	96.51		-.01		
Positive affect	9	14	.08	-.03, .18	99.46		-.06		
<u>Age</u>								.96	.02
Adolescents	5	8	.12	-.02, .24	98.23		-.02		
Adults	20	37	.13***	.07, .20	99.70		n/a		
Older adults	7	10	.14*	.02, .24	92.92		.01		
<u>Sex</u>								.50	.14
Both	21	28	.16***	.10, .23	97.92		n/a		
Female	7	14	.10	.00, .20	99.61		-.05		
Male	5	9	.07	-.04, .19	99.82		-.08		
<u>Study design</u>								.65	.01
Cross-sectional	25	46	.14***	.08, .20	99.63		n/a		
Longitudinal	7	11	.08	-.03, .20	97.13		-.06		
Experimental	1	1	.15	-.19, .45	n/a		.01		
<u>Risk of bias</u>								.94	
Total score /6							-.01		
Work-related PA	5	6	.10	-.02, .22	89.13				
<u>Outcome</u>								.10	.67
Mental health	2	3	.22***	.09, .34	88.66		n/a		
Mental wellbeing	2	2	.02	-.09, .14	85.29		-.20*		
Life satisfaction	1	1	.00	-.16, .16	n/a		-.22*		
<u>Age</u>								.002	.89
Adults	3	3	.02	-.09, .12	76.50		n/a		
Older adults	1	1	.37***	.17, .54	n/a		.36***		
<u>Sex</u>								.70	.09
Both	4	4	.10	-.04, .23	92.18		n/a		
Female	1	1	.09	-.02, .35	n/a		.10		
Male	1	1	.13	-.14, .04	n/a		-.01		
<u>Study design</u>								.80	.01
Cross-sectional	4	5	.11	-.03, .24	91.25		.11		
Longitudinal	1	1	.07	-.19, .32	n/a		-.04		
<u>Risk of bias</u>								.32	.20
Total score /6							-.36		
Transport-related PA	7	11	.13*	.02, .23	99.01	37			

<u>Outcome</u>								.37	.27
Mental health	2	3	.18*	.00, .34	66.09	n/a			
Mental wellbeing	3	3	.17*	.03, .30	99.33	-.00			
Life satisfaction	2	5	.02	-.14, .18	71.96	-.16			
<u>Age</u>								.44	.21
Adolescents	1	4	.02	-.09, .13	78.97	-.13*			
Adults	4	4	.13*	.02, .24	99.26	n/a			
Older adults	1	1	.26*	.02, .48	n/a	.14			
<u>Sex</u>								.70	.10
Both	5	5	.16**	.04, .26	99.11	n/a			
Female	2	3	.06	-.12, .24	87.03	-.09			
Male	2	3	.06	-.12, .24	83.32	-.10			
<u>Purpose of trip</u>								.01	.76
Not specified, or includes all travel	5	9	.05	-.02, .12	86.80	n/a			
To work	2	2	.28***	.19, .38	70.28	.24***			
<u>Risk of bias</u>								.15	.27
Total score /6						-.29			
Household PA	4	7	.04	-.02, .09	97.56				
<u>Outcome</u>								.03	1.00
Mental health	1	2	.00	.09, .17	n/a	n/a			
Mental wellbeing	2	4	.01	-.04, .06	98.62	-.12**			
Life satisfaction	1	1	-.01	-.06, .08	n/a	-.14**			
<u>Sex</u>								.20	.84
Both	2	2	-.01	-.09, .08	0.00	n/a			
Female	2	4	.04	-.01, .09	98.70	.00			
Male	1	1	.13*	.02, .24	n/a	.05			
<u>Study design</u>								.06	.24
Cross-sectional	3	6	.04	-.01, .10	97.95	n/a			
Longitudinal	1	1	-.01	-.14, .12	n/a	-.06			
<u>Risk of bias</u>								.25	.05
Total score /6						-.33			
School sport	2	5	-.04	-.29, .23	99.78				
<u>Outcome</u>								.36	.15
Mental health	1	1	.20	-.35, .65	n/a	n/a			
Life satisfaction	1	4	-.10	-.36, .18	n/a	-.30			
<u>Sex</u>								.13	.55
Both	1	1	.20	-.34, .75	n/a	n/a			
Female	1	2	-.30	-.63, .13	n/a	-.51*			
Male	1	2	.12	-.19, .40	n/a	-.09			
<u>Study design</u>								.36	.15
Cross-sectional	1	4	.14***	.08, .20	n/a	n/a			
Longitudinal	1	1	.08	-.03, .20	n/a	.30			

Physical education	2	10	.05	-.02, .13	96.27			
<u>Sex</u>							1.0	.00
Female	2	5	.03	-.05, .11	71.35	n/a		
Male	2	5	.07*	.00, .14	98.02	.05		

Note. Boldface indicates statistical significance. Fail-safe N is only included for meta-analysis effects that are significant. β = standardised regression coefficient; ES = effect sizes; $I^2 = I^2$ statistic indicating proportion of variation due to heterogeneity; k = number of studies; PA = physical activity; r = correlation effect size; R^2 = proportion of heterogeneity that can be explained by the moderator variable.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Leisure-time physical activity has a weak positive association with mental health. Despite large heterogeneity, Table 2 shows that the effect size is not significantly moderated by the mental health outcome, sex, age, or study design. Transport physical activity also has a weak positive association with mental health, but the CI is much wider for transport physical activity than leisure-time physical activity. The purpose of the trip (e.g., walking to work, walking during leisure-time) was the only significant moderator ($p = .01$) and explained majority of the variation in effect sizes ($R^2 = 76\%$). More specifically, active travel to and from work has a stronger relationship with mental health ($r = .28$) than active travel where the purpose was not identified or where all active trips were measured together ($r = .05$). While work-related physical activity is positively associated with mental health, heterogeneity is high and the relationship is not significant. Age is a significant moderator ($p = .002$) and explains 89% of the variance, as work-related physical activity is only positively associated with mental health in the one study examining older adults >65 years ($r = .37$), not in the three studies with adults <65 years ($r = .02$). Household physical activity, school sport, and physical education are not significantly associated with mental health.

Discussion

Overall, the key message from this meta-analysis is that the life domain in which physical activity is undertaken is an important factor that influences the strength and direction of the relationship between physical activity and mental health. While previous studies have demonstrated the importance of physical activity for mental health, results from this review suggest that this relationship is dependent on domain, as some physical activity domains appear to have little relationship with mental health, and physical activity accumulated at work may in fact be detrimental to mental health. This is an important finding given that physical activity guidelines currently encourage individuals to participate in physical activity during any life domain (Department of Health and Ageing, 2014; World Health Organization, 2010). Promoting physical activity specifically during leisure-time, compared to other physical activity domains, appears likely to be most beneficial in terms of mental health promotion and the prevention of mental ill-health.

One potentially important factor is motivation. Leisure-time physical activity is often a chosen behaviour, where individuals are likely to participate due to enjoyment or perceived benefits (McCarthy, Jones, & Clark-Carter, 2008; Seippel, 2006). Choosing to participate for enjoyment is central to self-determined motivation (Ryan & Deci, 2000a). Alternatively, work-related physical activity is likely to be viewed as a compulsory task and may be enforced by another person or merely carried out for the purpose of receiving an external reward (i.e., pay; Asztalos et al., 2009). If an activity is undertaken due to such factors, motivation is controlled and therefore, less self-determined than an activity which is autonomously chosen (Ryan & Deci, 2000a). Therefore, it seems possible that motivation towards physical activity may vary between different physical activity domains and may partially explain why leisure-time physical activity appears to be the most beneficial physical activity domain.

Self-determined motivation may also explain some of the variation within each physical activity domain. While transport physical activity appears to benefit mental health among adults, no such relationship was found for adolescents. It is possible that this finding reflects the mental health benefits experienced when adults personally choose to walk to work because it is enjoyable or important, while young people who are forced to walk to school do not experience the same benefit. However, as only one study sampled adolescents, further research is needed in order to determine whether efforts to increase active travel to school will increase mental health among students. Furthermore, Asztalos et al. (2009) reported that transport physical activity had a positive association with stress among blue collar workers, but no association among white collar workers. Financial factors may force some blue collar workers to cycle to work (i.e., controlled motivation), while white collar workers may be more likely to own a car and autonomously choose to walk or ride due to health benefits or enjoyment (Asztalos et al., 2009). However, the role of autonomous motivation in the relationship between physical activity and mental health has not yet been explored.

Increasing physical activity during work is not likely to be worthwhile in terms of reducing the prevalence of mental ill-health, as individuals with occupations that involve higher amounts of physical activity, such as blue collar jobs, are more likely to experience mental ill-health. Arguably, this may be the most important finding of this meta-analysis as it suggests that physical activity is not automatically associated with greater mental health and reduced mental ill-health, and that contextual factors are crucial to such relationships. It is possible that work-related physical activity does not provide a distraction from stress or provide opportunities for improved self-esteem, thereby not improving mental health. However, it is also possible that people with poorer mental health have limited occupational opportunities and secure employment in lower paid physically active jobs. Interestingly, work-related physical activity was

positively associated with mental health, but *only* for participants >65 years of age.

Given that individuals over 65 may be more likely to choose to continue employment, it is possible that they may be choosing to partake in active work that they enjoy, and this behaviour is more beneficial than not partaking in work at all for this age group.

Nevertheless, these findings demonstrate that work-related physical activity is associated with mental health for some people and mental ill-health for others.

Given that autonomy has been shown to mediate the effect of a school-based intervention on wellbeing (D. R. Lubans et al., 2015), perhaps physical activity at work may be linked to mental ill-health among those who have little autonomy in the workplace, but associated with positive mental health when workers' need for autonomy is satisfied. Furthermore, intensity and duration need to be examined within this domain as it seems plausible that intense physical activity that is physically demanding could be detrimental while light or moderate intensity physical activity may not have negative impacts. Nevertheless, only one study showed benefits of mental health and these findings warrant more extensive investigation of work-related physical activity in order to determine when it may be beneficial, as opposed to detrimental.

All significant effects identified within this study were small according to Cohen's (2013) guideline for interpreting the strength of correlations. However, Cohen's (2013) guidelines are not the only criteria by which an effect size should be interpreted (Vacha-Haase & Thompson, 2004). Small effects can sometimes be quite noteworthy, particularly if the outcome is valuable, important, and relevant to society, if intervention attempts have proved that achieving the same outcome through a different method (e.g., medication) is costly, or if repeated studies have continuously demonstrated the same effect (Prentice & Miller, 1992; Vacha-Haase & Thompson, 2004). Given that physical activity participation can be undertaken without large costs

to individuals, any degree of mental health improvement through physical activity is valuable. Additionally, physical activity benefits physical health (Janssen & LeBlanc, 2010) and, therefore, even a small effect on mental health is a public good. Further, when small effects are experienced continually as an ongoing process, effects may become larger over time (Prentice & Miller, 1992). Given that leisure-time physical activity only accounts for a small portion of people's weekly physical activity (Active Healthy Kids Australia, 2014; Carlson et al., 2016; Jurakić, Pedišić, & Andrijašević, 2009; M. P. Smith, Berdel, Nowak, Heinrich, & Schulz, 2016), and that previous meta-analyses on total exercise and mental health related outcomes have found larger effect sizes (Lawlor & Hopker, 2001a; Netz, Wu, Becker, & Tenenbaum, 2005), it seems possible that there may be an additive effect such that total physical activity may have a stronger relationship with mental health for some individuals. For example, adults who participate in both leisure-time physical activity and regular active travel may receive larger benefits than those who only participate in leisure-time physical activity. Examining different domains alongside rigorous measures of total physical activity is an important future direction. Nevertheless, physical activity participation is only part of the picture and certainly not the only method of treating and preventing mental ill-health.

Although moderator analyses revealed that the effect sizes were not moderated by the studies' risk of bias, it is noteworthy that only 18% of studies had a low risk of bias. As such, reducing the risk of bias in future studies is an important endeavour. Two of the most poorly met criterion were randomly selecting study participants (41%) and utilising a valid measure of physical activity (58%). As such, future studies should be encouraged to randomly select participants from nationally representative samples to increase the generalisability of results. Additionally, employing valid measurements of self-report physical activity would reduce the risk of bias; however, the shortcomings of

self-report methods have been widely discussed in the literature and it is important that objective measures are considered. While objectively measuring physical activity within specific domains is challenging and costly, advancements in technology have made it increasingly possible. Global positioning systems have been used to measure leisure-time physical activity (Ridgers & Fairclough, 2011), physical activity on school grounds (Schipperijn et al., 2012), and students' active travel to school (A. R. Cooper, Andersen, Wedderkopp, Page, & Froberg, 2005; Duncan, Badland, & Mummery, 2009; Rodriguez et al., 2012), while wearable cameras have been used to measure physical activity specifically during travel, work, and leisure-time (Ermes, Parkka, Mantyarvi, & Korhonen, 2008). Both devices make it possible to identify the life domain in which different physical activity bouts are undertaken.

According to Sallis' guideline for interpreting systematic review results, evidence is inconclusive if less than four studies are included (Sallis, Prochaska, & Taylor, 2000). This is important to note in terms of interpreting results for school sport and physical education. While school sport was inversely associated with mental ill-health, only two studies were included. Furthermore, while no relationship between physical education and mental health or mental ill-health was identified, there is not enough evidence to conclude that physical education is not beneficial for mental health. This warrants further investigation of these two domains.

Strengths and Limitations

This review provides the first meta-analytic evidence of the relationships between physical activity undertaken in different life domains, and mental health and mental ill-health. Consequently, it provides the most comprehensive evidence showing that leisure-time physical activity is the best physical activity domain in terms of promoting mental health and preventing mental ill-health. The number of studies and,

therefore, the total combined sample size, are both strengths of this study, as is the range of outcomes included. Nevertheless, some limitations should be noted. Firstly, all 98 studies utilised self-report measures of physical activity and secondly, only two experimental studies were included. The small number of studies included for work-related physical activity, transport physical activity, household physical activity, school sport, and physical education, in comparison to leisure-time, is also a limitation as a number of moderated meta-analyses could not be conducted within these domains due to insufficient studies. Finally, only including linear estimates of the relationship between physical activity and mental health may have oversimplified the relationships investigated. While only linear estimates could be meaningfully extracted from majority of the included studies, it is possible that exploring non-linear estimates in the future could assist in understanding differences between physical activity domains.

Conclusions

Despite the well accepted relationship between physical activity and mental health, this review concludes that the relationship between mental health and physical activity varies between different physical activity domains. In order to develop a more conclusive understanding, and improve the promotion of mental health through physical activity, further research on physical activity domains other than leisure-time is required, especially among adolescents. Gaining knowledge of the specific factors that mediate or moderate these relationships could lead to the development of contextually tailored interventions and physical activity guidelines, and improve the effectiveness of physical activity as a prevention and treatment method. Nevertheless, the results of this meta-analysis indicate that, compared to other physical activity domains, promoting physical activity during leisure-time is likely to be the most effective method of promoting mental health and preventing mental ill-health.

Synopsis

This chapter has presented meta-analytic evidence showing that leisure-time physical activity may be more beneficial to mental health than any other physical activity domain. This chapter also highlights the lack of domain-specific evidence among adolescents. The following chapter presents the results from Study 2, which explored the relationship between physical activity and affective wellbeing in relation to three specific physical activity domains commonly undertaken by adolescents. The following chapter will also present initial evidence regarding the role of motivation.

CHAPTER 3: Qualitative Investigation

A qualitative investigation of adolescents' motivation towards domain-specific physical activity and its perceived influence on positive and negative affect

Abstract

Objective: Abundant evidence shows that physical activity benefits adolescents' mental wellbeing. However, it is not well understood which physical activity domains are optimal for promoting mental wellbeing among adolescents. Even less is known about individual factors that may influence the relationship between domain-specific physical activity and affective wellbeing. The purpose of this study was to identify the relationships between physical activity in specific life domains and affective wellbeing as perceived by adolescents, and explore the role motivation may play in these relationships.

Methods: A sample of 114 adolescents (*M* age = 14.42 years) completed a computer-assisted-self-interview, where they were asked to recall physical activity experiences they believed led to positive and negative affect. Participants also responded to follow-up questions that explored when the activity occurred, their reason for participation, and with whom they participated in the activity. Participants then responded to questions specifically about physical activity during leisure-time, active travel to and from school, and physical education. Thematic analysis was performed on all data, and several frequency counts and descriptive statistics were conducted to supplement the emerging themes.

Results: Adolescents perceived that leisure-time physical activity led to positive affect because the activity was likely to be fun, increase self-esteem, and provide a sense of belonging. Active travel was associated with positive affect among those who

participated for enjoyment or health benefits, far more than those who participated because it was their only means of transportation. Similarly, those who believed physical education was fun and experienced a sense of belonging with their peers were more likely to report that physical education led to positive affect, compared to those who participated in physical education because they were forced. Across the three domains, controlled motivation appeared to prevent physical activity from benefiting mental wellbeing.

Conclusions: The domain in which physical activity is undertaken may influence the effect of physical activity on affective wellbeing. Additionally, promoting more autonomous forms of motivation may enhance the effect of physical activity on adolescents' wellbeing.

Introduction

It is well established in the literature that physical activity is associated with greater mental health and a lower likelihood of mental ill-health (Biddle & Asare, 2011). In order to optimally promote mental health and wellbeing through physical activity participation, research has begun to investigate the relationship between mental health and specific physical activity domains (i.e., areas of life which present opportunities for physical activity) such as leisure-time (Pahkala et al., 2007), work (K. Kim, Shin, Nam, Choi, & Kim, 2008), physical education (PE; Sallis et al., 2012), transportation (Carver et al., 2011), and housework (Jurakić et al., 2009). Evidence suggests that leisure-time physical activity has a stronger positive association with mental wellbeing than physical activity in other domains (see meta-analysis in Chapter 2).

Abundant studies have also investigated the amount (duration and frequency) and intensity of physical activity required to benefit mental health. However, results

suggest that both higher and lower amounts of physical activity are beneficial for mental health (Hassmén, Koivula, & Uutela, 2000; Paluska & Schwenk, 2000; Teychenne et al., 2008b). Moreover, evidence supports light, moderate, and vigorous intensity physical activity (Janssen & LeBlanc, 2010; Teychenne et al., 2008b, 2010). Parfitt, Rose, and Burgess (2006) instead investigated whether self-selecting the intensity of exercise was associated with post-exercise positive affect (i.e., a component of mental wellbeing; Diener, 2000; Fredrickson & Losada, 2005). Results showed that positive affect was higher following exercise when the intensity was self-selected, compared to both high and low intensity exercise with no choice (Parfitt et al., 2006). As such, it appears that choice may be more important to mental health than amount or intensity. Rose and Parfitt (2007b) further identified that feeling competent and in control were two reasons why participants experienced higher positive affect in response to the self-selected exercise condition.

As outlined in Chapter 1, self-determination theory (Deci & Ryan, 1985) classifies motivation along a continuum from self-determined to non self-determined and supports the idea that choice is important to the affective outcomes of an activity. Autonomous motivation is the most self-determined and is defined as acting “with a full sense of volition and choice because the activity is interesting or personally important” (Williams, 2002, p. 235). In the middle of the continuum lies controlled motivation – “engaging in an activity for internal (e.g., guilt) or external pressure (e.g., external rewards)” (Gillet et al., 2012, p. 455). Amotivation lies on the opposing end to autonomous motivation, is the least self-determined, and is defined as “lacking intention to act” (Deci & Ryan, 2002b, p. 17). Behaviours which are carried out due to autonomous motivation are expected to lead to more positive psychological outcomes than behaviours which are undertaken due to controlled motivation or amotivation, because they are more likely to satisfy peoples’ need for autonomy, competence, and

relatedness (Deci & Ryan, 2002a). Furthermore, it has been suggested that leisure-time physical activity may be a more self-determined behaviour compared to physical activity during other domains (e.g., active travel), and that this higher quality motivation may explain why leisure-time physical activity holds a stronger positive relationship with mental wellbeing (Asztalos et al., 2009; Kull et al., 2012). However, this hypothesis has yet to be examined in the context of domain-specific physical activity.

The first purpose of this study was to explore the perceived relationships between physical activity and affect among adolescents. The second purpose was to explore whether adolescents perceived physical activity within different domains to be differently associated with positive and negative affect. The final purpose was to investigate the role of self-determined motivation in the relationships between physical activity and affect within specific physical activity domains (i.e., leisure-time, active travel, and physical education).

Methods

Qualitative methods are important in understanding the mechanisms that underlie the effect of physical activity on wellbeing (Mutrie, 1997) and are particularly useful in understanding a relationship in detail in different contexts (Faulkner & Biddle, 2004). This study, therefore, adopted a qualitative methodology guided by realism (Pawson & Tilley, 1997) which was supplemented by descriptive quantitative analysis. Realism purports that investigating an event (i.e., physical activity) as well as the context and mechanisms associated with that event (i.e., life domain and self-determined motivation) lead to an enhanced understanding of the outcomes experienced (i.e., positive and negative affect; Pawson & Tilley, 1997).

Participants

Early adolescents were homogeneously sampled to describe the relationship between physical activity and affect in detail within a specific population (Patton, 2002). A convenience sample of 114 participants (M age = 14.42 years, SD = .58, 28% female) was recruited from two independent secondary schools in Western Sydney, Australia. While common guidelines recommend between 20 and 50 participants for qualitative studies (Creswell & Clark, 2007; Patton, 2002), the participants in this study answered questions in the absence of a researcher. Although the questions included numerous probes, there was no researcher present one-on-one with the participant to ask follow up questions. Therefore, a large sample size was advantageous as it ensured enough data was collected overall if some participants gave relatively short answers. The second reason for the large sample size was because of the need to recruit students from at least two different schools to increase triangulation, which is advantageous to the generalisability of the results (Patton, 2002). Data saturation then occurred after collecting data from two schools, as new data failed to add new themes or extend the understanding of existing themes (Weed, 2009). Further, the main aim of this study was to present qualitative findings; the quantitative results are merely included to supplement the qualitative results discussed. As such, 114 was deemed large enough for qualitative analysis, and a third school was not recruited. Ethics approval was received from the Western Sydney University Human Research Ethics Committee prior to data collection (see Appendix C for approval letter) and written parental consent and participant assent were obtained for each student (see Appendix D).

Procedure

Prior to data collection, the computer-assisted-self-interview was piloted among five adolescents aged 13-16 years of age. These adolescents completed the questions on the same device and were given the same instructions as the main sample. Additionally,

the pilot sample was encouraged to make notes about questions they did not understand or found difficult to answer and these issues were discussed with the researcher after completion. Overall, the questions appeared well understood and no changes were made.

During a scheduled lesson at school, participants in the main sample were provided with an iPad computer tablet with the computer-assisted-self-interview loaded on the screen. Participants responded to closed and open-ended questions at their own pace by selecting an answer button or typing on the onscreen keyboard. Closed-ended questions can be less intimidating than open-ended questions for young participants and provided a pathway towards open-ended questions (Irwin & Johnson, 2005) which obtain rich detail by enabling participants to respond in their own words (Kvale & Brinkmann, 2009). A computerised method of data collection was used to increase privacy and anonymity (Mensch, Hewett, & Erulkar, 2003; Morrison-Beedy, Carey, & Tu, 2006; Webb, Zimet, Fortenberry, & Blythe, 1999) encouraging adolescents to respond to health related questions honestly (P. D. Watson et al., 2001). Additionally, social desirability distortion is less likely to occur through computer-assisted-self-interviews than through face-to-face interviews (Richman, Weisband, Kiesler, & Drasgow, 1999). Furthermore, evidence suggests that when privacy is increased more in-depth responses are provided (Newman et al., 2002). Finally, students were informed that they were able to skip any question they felt uncomfortable answering.

Computer-Assisted-Self-Interview Questions

The questions first introduced the aim of the study and defined physical activity (see Appendix E for full list of questions). Next, a number of inductive questions asked the students how physical activity makes them feel and why they believe they feel this way. Continuing an inductive approach, but narrowing the focus, students were asked to

think of a time they participated in physical activity and felt good afterwards. A number of discrete emotions that reflect positive affect were provided (i.e., happy, cheerful, lively, proud, excited) to encourage students to think of a time when they participated in physical activity and experienced positive affect. These emotions were drawn from the positive affect subscale of the Positive and Negative Affect Scale (Lazarus & Cohen-Charash, 2001; D. Watson et al., 1988). Once the students thought of a particular physical activity experience, they were asked to describe the physical activity, reasons for their participation, where the physical activity occurred, and how they felt during and after participating in the activity. These questions provided insight into the students' motivation towards the physical activity experience and described the context of their activity in detail. The same questions were then delivered regarding an experience of physical activity in which the student felt unpleasant afterwards. The following words were provided to students to help elicit a physical activity experience associated with negative affect: sad, angry, anxious, shy, stressed, and humiliated. These emotions were taken from the negative affect subscale of the Positive and Negative Affect Scale (Clark & Watson, 1991).

The questions then adopted a more deductive approach where participants were asked to identify: how they feel when participating in physical activity during their own time (i.e., leisure-time), when actively travelling to or from school, and during physical education at school, by selecting from a list of positive and negative affective states. These closed-ended questions helped to understand whether adolescents perceived the domain of physical activity to influence the relationship between physical activity and affect and led into further open-ended questions, including why they participated in each physical activity domain. The purpose of this process was to examine whether the students' self-determined motivation towards physical activity varied across different

domains, and whether more positive affect was associated with more self-determined physical activity.

Data Analysis

First, all data was imported into NVivo qualitative data analysis software (version 10) and frequency counts were conducted for all closed-ended questions (e.g., when students were asked to select the emotions they associate with physical activity from a list such as “How do you feel when you participate in physical activity during your own time?”). Frequency counts were also conducted for open-ended questions such as “Please list three words that sum up how physical activity makes you feel.” This approach provided insight into the most common answers.

Thematic analysis was then carried out on the responses to all open-ended questions by linking a code (i.e., words or phrases) with sections of data that represented the participants’ perspectives (Patton, 2002). Codes derived can be either a manifestation of the data or latent in nature (Marks & Yardley, 2004). Research Question 1 (i.e., why do adolescents perceive physical activity to be associated with affect) and Research Question 2 (i.e., how does the relationship between physical activity and affect differ between domains) involved more inductive coding, where themes were derived from the data. However, Research Question 3 (i.e., what role does self-determined motivation play in the relationships between physical activity and affect within specific domains) was driven by an existing theory. Therefore, understanding the participants’ answers was also guided by theory, and latent codes were important. For example, participants did not use the words “autonomous” or “controlled” in their responses; however, based on self-determination theory tenets, latent codes mirroring autonomous motivation could be derived from quotes relating to undertaking physical activity because it was fun or because they enjoyed it (Marks & Yardley, 2004).

Deductively coding participants' responses based on self-determination theory tenets was advantageous in terms of exploring new links between physical activity and affective wellbeing based on an existing theory (Marks & Yardley, 2004).

The process of coding developed a hierarchy of codes with different links and relationships (Marks & Yardley, 2004) and the codes were grouped to develop broader categories (Patton, 2002). Categories were refined through this process and then used to illustrate patterns in the data (i.e., themes) to answer the main research questions. Finally, participants were assigned a code based on their answer to specific questions. For example, participants were placed into one of three categories based on their motivation towards active travel and were assigned a number from 1-3 accordingly. This process allowed participants to be separated based on their reported motivation so that frequency counts, descriptive statistics, and further thematic analysis could be conducted within each motivational category. Given that individuals often have multiple motives for participating in a behaviour, causing autonomous motivation and controlled motivation to sometimes co-exist (Langan et al., 2015), participants were categorised based on the strongest motivational construct. Hence, those categorised as autonomous were not necessarily purely autonomously motivated. This process facilitated exploration of the role of motivation in the relationships between physical activity and affect.

Results

Research Question 1: Physical Activity and Affective Wellbeing

Positive affect. Figure 4 shows the four main themes that arose explaining why physical activity was associated with positive affect, as perceived by adolescents. The first theme *fun and enjoyment* sums up the perceptions of many students who explained that participating in physical activity makes them feel happy because they find it fun

and enjoyable, as demonstrated by the following quotes: “physical activity makes me feel [happy] because I enjoy it” (Participant 26) and “physical activity makes me feel [happy] because it’s fun” (Participant 42).

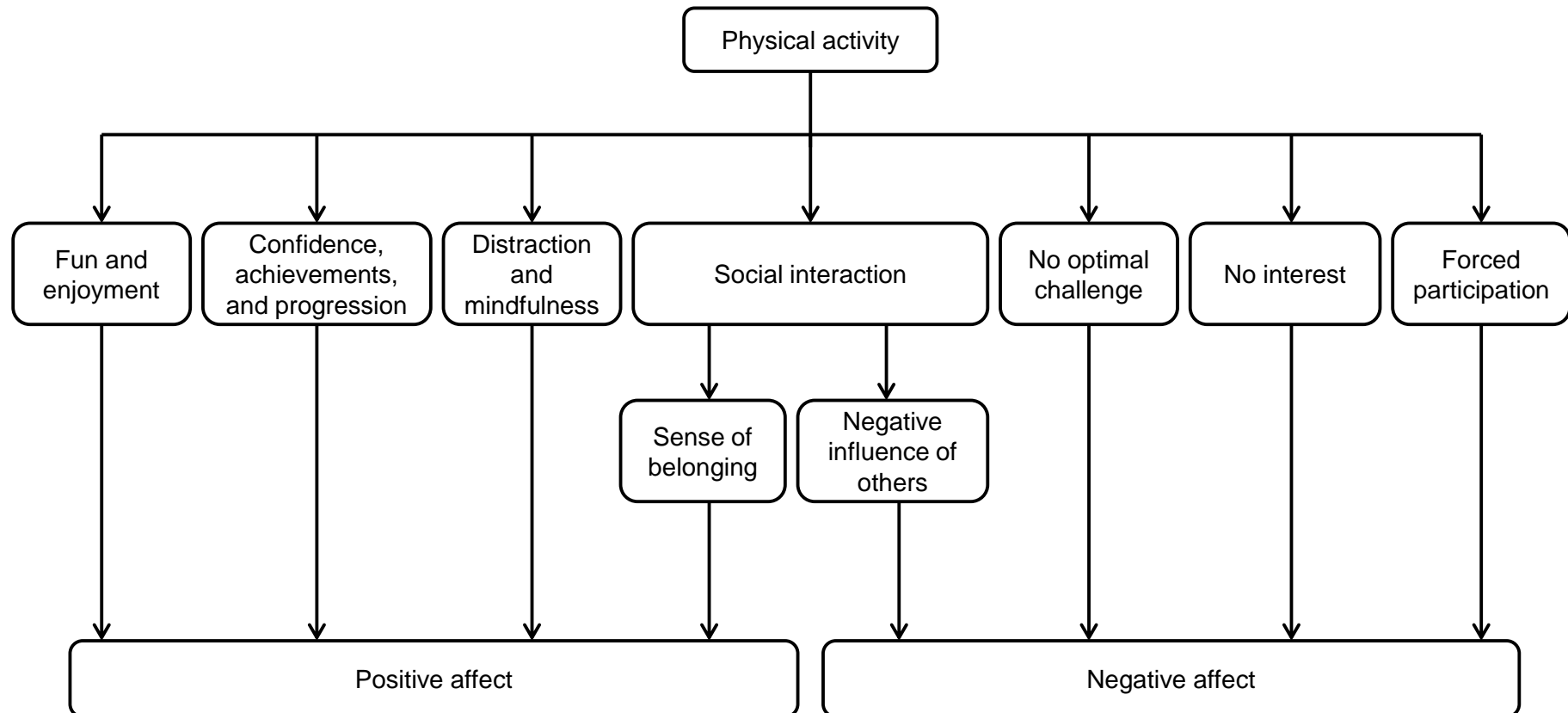


Figure 1. Why adolescents’ perceive that physical activity is associated with positive and negative affect.

The second theme *confidence, achievements, and progression* captures the perspectives of participants who explained that participating in sport generally makes them feel good about themselves and boosts their self-confidence. Many participants explained that experiencing improvements and achievements made them feel happy. For example, Participant 79 stated, “It makes me happy that I am progressing and can do the things I am told to do” while Participant 96 stated, “I always feel accomplished when I do physical activity and have a great sense of achievement, this makes me feel happy.” Similar to improvements and achievements, but more focused on an objective measurement of success rather than personal improvement, Participant 47 explained that “after winning a game you feel happy about yourself and what you have done to contribute to that victory.” Not only did participants report experiencing positive affect in response to sporting achievements, but many reported experiencing positive affect because they achieved health related goals as demonstrated by Participant 69: “It makes me feel proud because I have finished going for a run; it also makes me happy because I’m proud.”

The *distraction and mindfulness* theme consists of three smaller categories, the first is that physical activity is perceived to be a method of releasing anger which results in experiencing positive affect. Participant 91 explained that in martial arts, you “get to release any anger and negative energy and thoughts leaving only room for good ones.” As well as being a method of releasing anger, students identified that physical activity is a distraction from life stress. “It distracts you from what’s going on in your life” (Participant 32) and “it takes away life’s problems and releases stress” (Participant 48). Finally, some students further explained that not only does physical activity distract them from stress, but they mindfully focus on their sport, rather than thinking about other areas of life – “I feel happy because it takes my mind off stressful things (e.g.

exams) and makes me focus on the sport I'm participating in at the current time" (Participant 23).

The final theme entitled *sense of belonging* demonstrates that participants perceived physical activity led to positive affect if they experienced a sense of belonging with whom they were active: "When you play soccer you are in a team and this makes you feel part of a group and welcomed" (Participant 61) and "because I feel like I belong I feel happy" (Participant 10).

Negative affect. Despite many students perceiving that social interactions led to a sense of belonging and therefore positive affect, a number of participants discussed negative impacts of the other people with whom they do physical activity. The *negative influence of others* theme captures the idea that negative affect was derived through physical activity if students experienced judgment from others, felt self-conscious in front of others, or if negative peer comparisons were made. In terms of physical education, Participant 97 said, "I am not very good at sport, and so when I have to do things in front of lots of people I don't enjoy myself and can feel humiliated when I do something wrong." In terms of organised sport, Participant 82 explained, "swimming competitively is horrible, I felt sick to my stomach, I felt everyone's eyes burning into me watching me fail and come last."

The theme *no optimal challenge* summarises two smaller categories which contributed to negative affect. Firstly, if the challenge or task was perceived as too difficult such that the participants did not feel competent or comfortable in participating then the physical activity behaviour was associated with negative affect. For example, Participant 80 stated that:

The game [rugby league] is confusing and I don't know how to get involved. I try and participate as much as I can, but it's extremely

difficult. After the game I don't feel like I have accomplished anything, because I can't put everything into it.

Second, physical activity which is not optimally challenging is also associated with negative affect if participants perform poorly: "I was annoyed at myself because I got out so many times" (Participant 95).

In contrast to enjoyment being associated with positive affect, the *no interest* theme highlights that many participants explained that physical activities in which they were not interested were associated with negative affect. Participant 104 stated that she felt frustrated when dancing in a group at school because she "didn't enjoy it, it bored me and I only joined for my friend." The final theme that emerged as an explanation of why physical activity leads to negative affect was *forced participation* and reflects the notion that when students felt forced or obliged to participate in physical activity they experienced negative affect. Some participants explained this in relation to physical education: "I feel angry and frustrated because you have to do a sport that you don't have a choice in" (Participant 105). Others explained that they experienced negative affect when participating in organised sport because they felt forced to participate, as demonstrated by Participant 8: "I don't like the sport and felt I was forced to do the sport because I was good at it."

Research Question 2: Domain-Specific Physical Activity and Affect

When students were asked to describe a physical activity experience they believed led to positive affect, the most common words used to describe when that physical activity experience took place were on the weekend, after school, or during organised sport; all of which appear to be during leisure-time (Table 3). However, when students were asked to describe any physical activity experience they believed led to negative affect, school was the most commonly used word to explain when the physical

activity took place. However, a number of participants also associated negative affect with organised sport and physical activity on the weekend. As such, school was not only associated with negative affect and leisure-time was not only associated with positive affect, yet a higher number of students associated physical activity at school with negative affect, compared to positive affect. This inductive approach suggested that different affective outcomes may be experienced as a result of physical activity in different domains.

Table 3

Frequency Counts of the Most Common Words Used to Explain When Physical Activity Leads to Positive Affect as Opposed to Negative Affect

Positive Affect		Negative Affect	
Word	Frequency Count	Word	Frequency Count
Weekend	57	School	45
After school	33	Weekend	38
Organised sport	31	Organised sport	22
School	15	Physical education	18
Morning	8	After school	15

Further highlighting when physical activity is associated with positive affect compared to negative affect, Table 4 shows the number and proportion of participants who perceived physical activity to lead to positive and negative affect specifically within three different domains. Participants were most likely to report feeling happy, joyful, proud, and lively, and least likely to report feeling sad, afraid, miserable, and scared, when doing leisure-time physical activity. Overall, more students associated positive affect with leisure-time physical activity and physical education than active travel. Additionally, more students perceived active travel and physical education to be associated with negative affect than leisure-time physical activity. The following quote from Participant 90 highlights the view of many participants in relation to different physical activity domains:

I think having different settings in which I do physical activity can affect my emotions and moods as sometimes the task is not what I enjoy or it is something I have no choice in doing. When I'm dancing it is normally a choice for me to do it and I am interested in completing the activity, compared to playing football at school for example; as it is not a sport I enjoy it brings out more negative emotions and moods.

Table 4

The Association between Domain-Specific Physical Activity and Affect

	Leisure Time		Active Travel		Physical Education	
	Frequency	%	Frequency	%	Frequency	%
<u>Positive Affect</u>						
Happy	101	89%	33	37%	96	86%
Cheerful	73	64%	19	21%	77	69%
Joyful	72	63%	18	20%	65	58%
Proud	80	70%	16	18%	43	38%
Lively	88	77%	29	32%	75	67%
<u>Negative Affect</u>						
Sad	3	3%	6	7%	8	7%
Mad	8	7%	8	9%	8	7%
Afraid	4	4%	3	3%	8	7%
Miserable	2	2%	11	12%	16	14%
Scared	4	4%	8	9%	4	4%

Note. Frequency and % refer to the number of, and proportion of, students who indicated they experience that emotion during each particular physical activity domain.

Research Question 3: The Role of Self-Determined Motivation

All students discussed autonomous reasons for participating in leisure-time physical activity, with 52% reporting participating for enjoyment, and 48% for valued benefits. Alternatively, active travel was predominantly undertaken due to controlled motivation, with 67% stating they actively travel to school because it is their only means of transportation – only 11% participated for enjoyment and 22% because of valued health benefits. While 42% of students participated in physical education for autonomous reasons – 33% for enjoyment and 9% for valued benefits, 21% claimed

they participated in physical education because they were forced. The remaining 37% stated that they participate because they are forced and because they enjoy it. As shown in Table 5, those who participated in each domain for autonomous reasons reported rather different affective outcomes than those who participated due to controlled motivation.

Two categories are explained by the theme *autonomously motivated physical activity is perceived to be associated with positive affect*. The first category explains that among the physical activity experiences that participants associated with positive affect, the most common reason for participation was enjoyment. Students commonly reported that they did the activity because they enjoy it, they love the sport, they are passionate about the sport, or because it is fun, as highlighted in the following quotes: “I participate in basketball because it is fun and enjoyable to do” (Participant 2), “I do motorcross racing because I like it and have a lot of fun doing it” (Participant 13), and “I do oz-tag because I wanted to play with my friends and have fun” (Participant 53). The second category within this theme shows that physical activity associated with positive affect was commonly undertaken “to keep fit and feel good” (Participant 11, Soccer), “to gain strength” (Participant 27, gym), and to “to relieve stress and feel better about myself” (Participant 85, running); all of which are valued benefits of physical activity, and therefore autonomous reasons for participation.

Table 5

The Association between Affect and three Physical Activity Domains according to Participants' Main Reason for Participation

	Leisure Time				Active Travel						Physical Education								
	Enjoyment		Health benefits		Fun		Health benefits		Only method		Enjoyment		Health benefits		Forced to participate		Compulsory, but I enjoy it		
	59		55		5		10		31		36		10		23		41		
<i>n</i>	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
<u>Positive Affect</u>																			
Happy	49	83%	47	85%	5	100%	10	100%	10	32%	35	97%	9	89%	15	65%	35	86%	
Cheerful	37	63%	36	65%	4	80%	5	50%	6	18%	33	92%	7	67%	9	39%	27	66%	
Joyful	44	75%	39	70%	3	60%	3	33%	8	25%	31	86%	6	56%	5	22%	23	55%	
Proud	40	67%	33	60%	2	40%	5	50%	8	25%	19	53%	7	67%	4	17%	13	32%	
Lively	57	96%	47	85%	4	80%	8	83%	12	39%	27	75%	7	67%	8	35%	31	75%	
<u>Negative Affect</u>																			
Sad	2	4%	0	0%	1	20%	0	0%	4	14%	1	3%	0	0%	6	26%	1	2%	
Mad	8	13%	6	10%	1	20%	0	0%	7	21%	1	3%	1	11%	4	17%	2	5%	
Afraid	5	8%	3	5%	1	20%	0	0%	1	4%	0	0%	0	0%	2	9%	5	11%	
Miserable	5	8%	0	0%	1	20%	0	0%	10	32%	2	6%	2	22%	8	35%	4	9%	
Scared	2	4%	0	0%	1	20%	0	0%	2	7%	1	3%	0	0%	2	9%	1	2%	

Note. % refers to the proportion of students who indicated they experience each emotion during each particular physical activity domain, according to their reason for participating in that physical activity domain.

Alternatively, data relating to physical activity associated with negative affect revealed two categories explained by the theme *physical activity undertaken due to controlled motivation was associated with negative affect*. The first category within this theme shows that participants took part in physical activity that they associated with negative affect because they felt pressured or encouraged to by another person. Students reported that they participated because their friends did – “cause my mates play Rugby Union” (Participant 6), because their parents encouraged them to – “because I was encouraged by my parents and I was good at swimming” (Participant 91), and because their teacher told them to – “I swam in the school swimming carnival because my homeroom teacher made me” (Participant 82). The second category explains that participants took part in physical activity which they associated with negative affect because they felt they had no choice but to participate and they felt forced. Some students reported that their parents told them to – “my parents said I needed to try a summer sport” (Cricket, Participant 74), while many students reported that they participated because either their school or teacher forced them – “school makes me, they force you to do PE” (Participant 67). Similarly, Participant 9 said “I did it because that’s what the teacher chose.”

Leisure-time. Within leisure-time physical activity, the students’ main reasons for participation were enjoyment and health benefits. Nearly all students spoke about how doing physical activity during leisure-time was their choice as highlighted by Participant 80, “It’s completely my choice, I do it because I love it.” Although participating for enjoyment is more self-determined than participating for valued benefits, both are autonomous in nature and students participating for both reasons associated leisure-time physical activity with positive affect far more than negative affect (see Table 5). Additionally, participants explained that they experience positive affect such as happiness because they are choosing to do something that they enjoy, “I

have the choice to participate, I do it because I enjoy it and because I have passion for the sport it brings me joy when I play” (Participant 21).

Active travel to school. In contrast to leisure-time physical activity, the most common reason adolescents reported walking or riding a bicycle to school was because it was their only means of getting to and from school. This reason for participation was demonstrated by Participant 112 who stated:

I have to walk home from school because it is my only means of getting home. I don't have much choice if my mum is busy and she can't pick me up I have to walk. I feel miserable when I have to walk because it is a long way and my bag is heavy.

Fewer participants explained that they travelled actively to school because it's fun or because they know it's good for them, as highlighted by Participant 108, “I like to ride to school because riding my bike is fun. I believe I feel happy, cheerful, joyful, and lively because I love riding.” Participant 94 highlighted walking for health benefits:

I walk home from school sometimes for exercise. My parents come to pick my brother up so I could get a ride with them, but I choose to walk because I just like to. It makes me feel healthy and fit and good about myself because I'm choosing to do something healthy.

As shown in Table 5, walking to school was associated with feeling happy by all students who reported walking because it's fun or for health benefits (i.e., autonomously motivated), but by only 32% of students who walk because it's the only method of travel (i.e., controlled motivation). The following two quotes further illustrate why walking for enjoyment is associated with positive affect but being forced to walk is not.

I sometimes catch the bus to the shopping centre and meet up with friends to walk to school. I have the choice to catch the bus straight to school if I want but I rather walk because I'm happy and relaxed when I walk to school because I'm with my friends and they keep my mind off things I could be stressed about (Participant 21).

Conversely, Participant 84 stated that:

I have to walk to my house from the bus stop in the afternoon because my parents are at work and can't pick me up from school. I feel as if I'm just wasting my time. I'm tired, hungry, hot, stressed, and not in the mood for walking with a heavy school bag.

Physical education. Some students reported participating in physical education because they enjoy it or because it's a way of doing exercise which is good for them. Participant 25 stated "I participate in physical education at school because I enjoy it and it keeps me fit and healthy, not only in a physical sense but also mentally." Others indicated that they participated because they were forced. Participant 79 stated:

I only participate in physical education because I am made to, I have no choice. We don't get provided with input. I feel miserable and mad because I am being forced to do it and I don't like the sports that we do.

As shown in Table 5, out of those who participated because they felt forced (i.e., controlled motivation) more participants reported feeling sad, mad, afraid, miserable, and scared, than happy, cheerful, joyful, proud, and lively, compared to those who reported doing physical education because it's fun or because it's good for them (i.e., autonomous motivation). However, many students identified that they do physical education because they are forced to and because they enjoy it. Interestingly, a higher

proportion of these students associated physical education with positive affect compared to the students who only participate because they feel forced, but a smaller proportion associated physical education with positive affect, compared to those who participate purely because of enjoyment.

Discussion

This study indicated that adolescents perceived physical activity to be associated with both positive and negative affect, suggesting that physical activity may not necessarily always be associated with affective wellbeing. Further, more adolescents perceived positive affect to be associated with physical activity during leisure-time than physical activity as a means of transportation or physical activity at school (e.g., physical education). Finally, adolescents associated positive affect with physical activity in which they autonomously chose to participate, while they associated negative affect with physical activity they felt pressured or forced to undertake.

Self-determination theory purports that the degree to which a behaviour is autonomously motivated influences the effect of that behaviour on psychological wellbeing (Deci & Ryan, 1985). More specifically, behaviours that are autonomously undertaken are more likely to be associated with greater psychological wellbeing compared to activities which are carried out due to controlled motivation (Deci & Ryan, 2008a, 2008b; Ryan & Deci, 2000a). Findings from this study support this notion as physical activity behaviours that adolescents associated with positive affect were largely undertaken for autonomous reasons, including enjoyment (i.e., intrinsic motivation) and valued benefits (i.e., identified regulation). Conversely, physical activity experiences that adolescents associated with negative affect were predominantly undertaken for more controlled reasons. Controlled reasons for participation included feeling pressured to do a sport due to cultural background, family history, or because their friends played

(i.e., introjected regulation) as well as being forced to participate, either by their parents in terms of active travel or by their teachers in terms of physical education (i.e., external regulation).

The reason self-determination theory suggests that more autonomous behaviours are likely to be associated with greater mental health benefits is because individuals are likely to autonomously choose to participate in activities that satisfy their psychological needs of autonomy, competence, and relatedness (Weinstein & Ryan, 2010). Given that these three psychological needs must be satisfied for optimal wellbeing (Deci & Ryan, 2002a), basic psychological needs theory explains that activities which satisfy these needs are more likely to be associated with positive affect. Conversely, the extent to which psychological needs are not satisfied influences the likelihood of a behaviour being associated with negative psychological outcomes (Ryan & Deci, 2002). Results supported this notion, as physical activity experiences that were associated with negative affect were also associated with feeling incompetent or performing poorly, while physical activity experiences that adolescents associated with positive affect were associated with feelings of achievement and progress. This finding provides some support for the mastery hypothesis which explains that participating in physical activity enhances feelings of success and confidence, which benefits mental health when the feeling of mastery is carried into other areas of life (Paluska & Schwenk, 2000). Further, this finding also identifies that the satisfaction of competence may explain why physical activity during leisure-time is beneficial to mental wellbeing. However, given that not all physical activity experiences are necessarily associated with feelings of competence and mastery, other mechanisms must also play a role.

Teychenne et al. (2010) found that participants who completed some of their leisure-time physical activity with another person were less likely to experience

depression compared to individuals who completed all leisure-time physical activity alone. Nevertheless, the relationship was not linear and it was suggested that mental health benefits may be derived from participating in leisure-time physical activity with others; however, not all physical activity with others is necessarily beneficial (Teychenne et al., 2010). The results from this study augment this idea by further explaining that adolescents perceived physical activity with others to be beneficial if a sense of belonging was experienced, but damaging if judgment occurs or peer comparisons are made. Given that relatedness is defined as the fundamental need to maintain close personal connections with other people and feel like a valuable and cared for member of a group (Baumeister & Leary, 1995), it is apparent that relatedness experienced during physical activity is beneficial to positive affect experienced during and after physical activity. Many adolescents perceived that one of the reasons they chose to participate in physical activity during leisure-time was because they felt a sense of belonging with their friends and teammates. However, few participants reported walking to school with a friend. This may be partially why, compared with active travel, leisure-time physical activity was more often associated with positive affect. In terms of physical education, students who claimed that they enjoyed playing sport with their peers during physical education experienced a sense of belonging and positive affect, while those who felt judged and embarrassed in front of their peers experienced negative affect when participating in physical education. Hence, this study suggests that merely participating in physical activity with others is not necessarily beneficial; instead, the satisfaction of relatedness appears to influence whether physical activity is associated with positive affect or not, and is therefore an important mechanism.

Results from this study also support quantitative evidence showing that leisure-time physical activity is more positively associated with mental wellbeing than physical activity during other domains (see Chapter 2). However, adolescents accumulate a large

portion of their weekly physical activity during school (42%; Carlson et al., 2016). As such, greater understanding of the relationship between school-based physical activity and mental health is necessary. Although many students perceived school sport and physical education to be enjoyable and led to positive affect, those who were extrinsically motivated by teachers' control were less likely to believe physical education was associated with positive affect. As such, controlling teacher behaviours not only contribute to reduced autonomous motivation and reduced physical activity (Hagger et al., 2009; Standage, Duda, & Ntoumanis, 2006), but may also undermine the wellbeing benefits of physical education. Hence, autonomy supportive behaviours should be promoted further in the future; not only to increase physical activity, but also to enhance the effect of school based physical activity on students' wellbeing (Cheon, Reeve, & Moon, 2012).

Strengths and Limitations

The key strength of this study was that it was the first to explore adolescents' perceived affective wellbeing in relation to a range of different physical activity domains, and develop an initial understanding of the role that self-determined motivation plays. The method of data collection (i.e., computer-assisted-self-interview) was also a strength as it allowed for a large sample size and ensured complete anonymity of responses thereby encouraging participants to discuss their views honestly and in depth. Finally, the mixed methods approach of using descriptive statistics and frequency counts to supplement the in-depth thematic analysis was also advantageous to explaining a phenomenon that was previously unstudied.

Some limitations should also be noted. Recalling positive and negative affect as opposed to measuring affect during or immediately after physical activity, can be influenced by recall biases which may introduce error (Hufford, 2007). Also, this study

investigated adolescents' perceived affective states during and after different physical activity experiences. Quantitative evidence employing validated psychological measures would be useful as they allow for more rigorous measurement of affect. Further, employing such measures would also enable the assessment of more stable affective states. This is important as physical activity behaviours that have a perceived immediate impact on affect, either positive or negative, may not influence longer term mental health and wellbeing. Furthermore intrinsic motivation is partially defined by positive emotions such as enjoyment, and external regulation is partially defined by negative emotions such as guilt. Given that intrinsic motivation falls under autonomous motivation and external regulation falls under controlled motivation, it is possible that measurement issues are responsible for some of the results identified in this study and further investigation is warranted. Additionally, mental wellbeing is comprised of both affective (i.e., emotions and moods) and cognitive (i.e., evaluations of life satisfaction) components (Luhmann et al., 2012). As such, measuring cognitive wellbeing in addition to affective wellbeing could provide a more detailed understanding of mental wellbeing. Finally, quantitatively testing the perceived relationships identified in this study would enable results to be generalised to a broader sample.

Conclusions

This study suggests that different physical activity experiences have varying impacts on adolescents' affective wellbeing. As such, promoting physical activity participation may not always be beneficial to mental wellbeing. It appears that promoting autonomously motivated physical activity which satisfies students' psychological needs is likely to be the most effective method of enhancing adolescents' mental wellbeing through physical activity.

Synopsis

This chapter discussed the findings of a qualitative investigation of domain-specific physical activity, temporary affect, and motivation. The following chapter discussed the development of a measure of motivation which leads towards quantitatively testing the findings presented in this chapter among a broader sample using valid measures of physical activity, motivation, and affect.

CHAPTER 4: Scale Development

The Motivation towards Active Travel to School Scale (MATSS): Instrument development and initial validity evidence

Abstract

Objective: Grounded in a self-determination theory framework, this study aimed to develop and assess the psychometric properties of a brief measure of adolescents' motivation towards active travel to school.

Methods: The Motivation towards Active Travel to School Scale (MATSS) was developed in three phases. In Phase 1, 25 self-determination theory experts rated the content validity of 28 initial items and Aiken's item content-validity coefficients (V) and Cohen's effect sizes (d) were calculated. Items that did not reach the validity coefficient threshold ($V = .63$), or the effect size was not acceptable ($d < .80$) were removed. Expert reviewers' comments were also considered to remove further items to increase the brevity of the scale. In Phase 2, 239 adolescent boys (M age = 13.25 years, $SD = .67$) completed a revised 16-item MATSS and confirmatory factor analysis (CFA) was used to explore factorial validity of the test scores. In Phase 3, a cross validation sample of 1,447 adolescents (M age = 12.94 years, $SD = .54$) completed the revised 9-item MATSS as well as a measure of motivation towards leisure-time physical activity (BREQ-2), and CFA was conducted including testing for gender invariance.

Results: In Phase 1, 24 items exceeded the validity coefficient threshold ($V = .63$) and showed acceptable effect sizes ($d \geq .80$) and were retained. A further eight items were removed from analyses based on the expert reviewers' written comments. A preliminary three-factor (16-items) model suggested poor fit to the data and a further seven items were removed based on low factor loadings or high cross loadings. The data fit the

revised 9-item model well in both the initial sample (CFI = .95, SRMR = .07, RMSEA = .06) and the cross validation sample (CFI = .95, SRMR = .06, RMSEA = .06). The 9-item model was also invariant across gender and correlations between the MATSS and BREQ-2 factors suggested convergent validity.

Conclusions: This study provided validity evidence of the MATSS scores among adolescents from Sydney, Australia. The MATSS can be used to investigate what factors influence active travel motivation (e.g., social interaction or green space), whether motivation predicts active travel behaviour, and whether motivation enhances the effects of active travel on psychological and educational outcomes.

Introduction

Physical activity is linked to many health benefits for adolescents including lower blood pressure, increased musculoskeletal fitness, and a reduced risk of obesity, diabetes, depression, and anxiety (Biddle & Asare, 2011; Janssen & LeBlanc, 2010). Additionally, physical activity holds benefits for psychological wellbeing (Ussher, Owen, Cook, & Whincup, 2007), physical self-concept (Babic et al., 2014), school engagement (Owen et al., 2016), and academic achievement (Singh, Uijtdewilligen, Twisk, Van Mechelen, & Chinapaw, 2012). Yet globally, only 20% of adolescents participate in ≥ 60 minutes of moderate-to-vigorous physical activity each day (Hallal et al., 2012). Failure to substantially increase adolescents' participation in leisure-time physical activity (e.g., exercise and sport) has led to an increased interest in investigating more incidental forms of physical activity that can contribute to total physical activity (Sallis et al., 2006).

Active travel is one type of physical activity that can contribute to higher levels of total weekly physical activity (Sallis et al., 2006). Active travel includes any physically active mode of transport (e.g., cycling or walking), either on its own or in

combination with public transport (Hardy et al., 2011; Merom et al., 2006). Students who walk to and from school accumulate 26 additional minutes of moderate-to-vigorous physical activity on average per weekday compared to those who travel by bus or car (Alexander et al., 2005). Additionally, active travel is positively associated with cardiorespiratory fitness and healthy body weight in youth (D. R. Lubans, Boreham, Kelly, & Foster, 2011). Nevertheless, evidence shows that prevalence rates are remarkably low in many western countries, with 20% reported in Australia (Schranz et al., 2014) and 13% reported in the United States (McDonald, 2007). Furthermore, research consistently demonstrates a global decline in adolescents' active travel (Hillman, 1993; McCann & DeLille, 2000; Van der Ploeg, Merom, Corpuz, & Bauman, 2008).

Understanding the determinants of active travel is necessary in order to promote participation. The majority of research has investigated the influence of the physical environment and parental factors on adolescents' mode of travel to and from school. While distance between home and school may prevent some students from travelling actively, half of students who live within a walkable distance (i.e., <1.5km) are driven to school (Wen et al., 2008). Furthermore, the walkability of a neighbourhood and parental control over mode of transport have limited influence on adolescents' active travel (Carver, Timperio, Hesketh, & Crawford, 2010; Kerr et al., 2006). As such, it appears that – despite playing a role – the physical environment and parental influences are not the sole determinants of adolescents' active travel behaviour, and investigations of individual determinants (e.g., motivation) are warranted.

Self-determination theory (Deci & Ryan, 1985) distinguishes between different types of motivation and has been utilised to explain adolescents' physical activity participation, or lack thereof, during leisure-time (Plotnikoff, Costigan, Karunamuni, &

Lubans, 2013) and physical education (Owen, Smith, Lubans, Ng, & Lonsdale, 2014). Research shows that autonomous motivation predicts sustained physical activity behaviour, while controlled motivation and amotivation do not (Teixeira, Carraça, Markland, Silva, & Ryan, 2012). However, there has been no examination as to whether more self-determined motivation (i.e., autonomous motivation) is associated with active travel participation. Pratt et al. (2004) and Sallis et al. (2006) have suggested that because people participate in different physical activity behaviours for different reasons, antecedents and outcomes of physical activity are likely to vary across different physical activity domains as well.

Within self-determination theory, autonomous motivation is defined as acting “with a full sense of volition and choice because the activity is interesting or personally important” (Williams, 2002, p. 235). Thus, students who walk to school because of the enjoyment they experience while walking would be autonomously motivated. Controlled motivation refers to “engaging in an activity for internal (e.g., guilt) or external pressure (e.g., external rewards)” (Gillet et al., 2012, p. 455) and may be present when students walk to school because their parents pressure them or because they want to avoid guilt derived from travelling passively. Finally, amotivation is defined as a “state of lacking intention to act.... Either they do not act at all or they act... with no sense of intending to do what they are doing” (Deci & Ryan, 2002b, p. 17). Students who walk to school, but believe there is no point in doing so, are amotivated. Therefore, a self-determination theory framework may be a useful basis for understanding adolescents’ participation in active travel. Furthermore, self-determination theory may provide a beneficial approach to understanding whether students whose active travel is underpinned by autonomous motivation experience more positive outcomes (e.g., subjective wellbeing; Asztalos et al., 2009), compared to those who actively travel due to controlled forms of motivation.

Despite the development of a number of instruments that employ a self-determination theory framework to measure motivation towards physical activity in other domains such as competitive sport (Lonsdale, Hodge, & Rose, 2008) and physical education (Goudas, Biddle, & Fox, 1994), no such measure exists for active travel. Therefore, the first purpose of this study was to develop the Motivation towards Active Travel to School Scale (MATSS); a brief instrument measuring students' autonomous motivation, controlled motivation, and amotivation towards active travel to and from school. The second purpose was to evaluate the psychometric properties of the MATSS among adolescents.

Phase 1: Item Development

Methods

The underlying constructs that need to be measured in this study, as well as in the remainder of the thesis, are autonomous motivation, controlled motivation, and amotivation. Therefore, the first step in developing an instrument is to define each construct. Autonomous motivation, controlled motivation, and amotivation are defined in the introduction and are what the instrument is designed to measure. Because these constructs cannot be observed directly, they are referred to as latent variables, and a number of items that can be directly measured must be developed (DeVellis, 2012). A participant's score on a latent variable is then based on their responses to each of the items (DeVellis, 2012). Therefore, the next step after defining the latent variables was to develop a number of preliminary items based on the three conceptual definitions.

While there is no criteria for the exact number of items required in this phase, the initial item pool should consist of considerably more items than what is planned to be included in the final instrument (DeVellis, 2012). It was intended that a brief instrument be developed, between nine and 12 items in length, so that the measure could

be administered alongside other scales (Marsh, Ellis, Parada, Richards, & Heubeck, 2005). Therefore, the initial item pool consisted of 28 items. Ten items reflected autonomous motivation, 13 controlled motivation, and five amotivation. Researchers who had published peer reviewed articles in the area of self-determination theory were recruited as expert judges to assess item content relevance (Dunn, Bouffard, & Rogers, 1999). Each of the 25 expert judges rated the degree of match between each of the 28 items and the three motivation constructs (autonomous motivation, controlled motivation, and amotivation) on a 5-point Likert scale, where 1 equals a *poor match* and 5 equals an *excellent match* (Dunn et al., 1999). The expert judges were also encouraged to comment on the content or wording of any of the items.

Data Analysis. First, Mahalanobis distances were calculated to identify multivariate outliers (i.e., experts whose ratings deviated significantly from the other experts' ratings across multiple items; Tabachnick & Fidell, 2013). Next, the mean, standard deviation, and Aiken's item content-validity coefficient (V) were calculated for each item. Aiken's item content-validity coefficients determined the relevance of each item to each construct (i.e., autonomous motivation, controlled motivation, and amotivation). When $V = 1$, all judges would have rated the match between the item and the construct as excellent (Dunn et al., 1999). Where $V = 0$, all judges would have indicated that the match between the item and the construct was poor (Dunn et al., 1999). With 25 expert reviewers, V values are significant at $p < .05$ for $V = .63$ (Aiken, 1985). Finally, Cohen's (1977) effect size indices were calculated to indicate the magnitude of difference between the mean expert rating for each item on each of the three subscales. A large effect size ($\geq .80$) indicates a large difference between the mean rating for that item on two different subscales (i.e., the subscale it was intended to measure and a subscale to which it should not be theoretically related). Therefore, effect

sizes $\geq .80$ indicate that the item was only relevant to the intended subscale and should be retained for further analyses.

Results

All experts' Mahalanobis distances were lower than the critical value of 20.52 (Tabachnick & Fidell, 2013). As such, no multivariate outliers were detected and no experts' ratings were removed from analysis. The validity coefficients of 24 of the 28 initial items were significant ($V \geq .63, p < .05$) and are shown in Table 6. The four items that did not statistically show significant relevance to the intended construct were removed from further analyses. Cohen's d values of all 24 retained items were $\geq .80$, suggesting that each item was only relevant to the construct it was intended to measure (Table 7). Given that the number of items with acceptable content validity (i.e., 24) was larger than the number of items needed for the final MATSS, a further eight items were removed. The items removed had either a lower V coefficient compared to the retained items in the same subscale, or negative comments provided by the self-determination theory experts. Two items were removed from the autonomous subscale ($V = .64 - .78$) and six items were removed from the controlled subscale ($V = .73 - .95$). The remaining 16 items had a high V coefficient and no disagreement between self-determination theory experts regarding the wording of the item. These 16 items collectively covered all components of the three conceptual definitions (autonomous motivation, controlled motivation, and amotivation) and were retained for further assessment in Phase 2.

Table 6

Mean Ratings and Content Validity Coefficients of the Initial Items

I actively travel to school...	Autonomous Motivation			Controlled Motivation			Amotivation		
	<i>M</i>	<i>SD</i>	<i>V</i>	<i>M</i>	<i>SD</i>	<i>V</i>	<i>M</i>	<i>SD</i>	<i>V</i>
1. Because it is fun.	4.92	.28	.93	1.00	.00	.00	1.00	.00	.00
2. Because I enjoy it.	4.92	.28	.93	1.00	.00	.00	1.00	.00	.00
3. Because I'll miss out on an enjoyable activity if I don't.	3.00	1.26	.50	2.12	1.24	.28	1.24	.72	.06
4. Because I find it pleasurable.	4.52	1.05	.88	1.08	.28	.02	1.00	.00	.00
5. Because it is interesting.	4.76	.52	.94	1.00	.00	.00	1.00	.00	.00
6. Because it is personally important to me.	4.71	.62	.88	1.28	.54	.07	1.00	.00	.00
7. Because I think it's a worthwhile thing to do.	4.12	1.05	.78	1.46	.78	.10	1.00	.00	.00
8. Because if I don't, I miss out on personally valuable benefits.	3.40	1.26	.60	2.08	1.15	.27	1.08	.40	.02
9. Because the benefits are important to me.	4.00	1.18	.71	1.60	.96	.15	1.00	.00	.00
10. Because I think it is good for me.	3.56	1.08	.64	1.92	1.12	.23	1.00	.00	.00
11. Because I feel guilty if I don't.	1.16	.62	.04	4.92	.28	.98	1.00	.00	.00
12. Because I feel bad about myself if I don't.	1.00	.00	.00	4.88	.33	.97	1.04	.20	.01
13. Because I feel lazy if I don't.	1.08	.28	.02	4.08	1.35	.77	1.16	.47	.04
14. Because I need to do it to feel good about myself.	1.32	.63	.08	4.24	.78	.81	1.04	.20	.01
15. Because it makes me feel worthy as a person.	1.44	.96	.11	3.92	1.08	.73	1.04	.20	.01
16. Because other people (e.g., parents, friends) get angry with me if I don't.	1.00	.00	.00	4.80	.50	.95	1.08	.40	.02
17. Because other people (e.g., parents, friends) get upset with me if I don't.	1.00	.00	.00	4.60	.91	.90	1.08	.40	.02
18. Because other people (e.g., parents, friends) tell me I should.	1.00	.00	.00	4.56	.92	.89	1.04	.20	.01
19. Because other people (e.g., parents, friends) force me to.	1.00	.00	.00	4.56	1.04	.89	1.12	.60	.03
20. Because I feel under pressure from other people (e.g., parents, friends).	1.00	.00	.00	4.64	.95	.91	1.08	.40	.02
21. Because other people (e.g., parents, friends) pressure me.	1.00	.00	.00	4.52	1.16	.88	1.12	.60	.03
22. Because there is no other way for me to get to school.	1.12	.33	.03	2.44	1.29	.36	2.00	1.19	.25
23. Because I have no choice.	1.12	.60	.03	2.84	1.28	.46	2.12	1.27	.28
24. And there may be good reason to, but I personally don't see any.	1.04	.20	.01	1.12	.33	.03	4.04	1.34	.76
25. But I don't see why I should.	1.04	.20	.01	1.16	.47	.04	4.36	1.15	.84
26. But I feel it is a waste of time.	1.00	.00	.00	1.08	.28	.02	4.20	1.35	.80
27. But I don't see the point.	1.08	.40	.02	1.08	.28	.02	4.28	1.21	.82
28. But I'm not sure if it's worth it.	1.00	.00	.00	1.20	.50	.05	4.08	1.29	.77

Note. Retained items are bolded. *V* = Aiken's item content-validity coefficient.

Table 7

Effect Size Indices of the Initial Items

I actively travel to school...	Autonomous	Controlled	Amotivation
	vs Controlled	vs Amotivation	vs Autonomous
1. Because it is fun.	18.48	-	18.48
2. Because I enjoy it.	18.48	-	18.48
4. Because I find it pleasurable.	5.20	0.38	4.98
5. Because it is interesting.	10.63	-	10.63
6. Because it is personally important to me.	6.21	0.79	8.74
7. Because I think it's a worthwhile thing to do.	2.77	0.81	4.01
9. Because the benefits are important to me.	2.17	0.85	3.54
10. Because I think it is good for me.	1.49	1.18	3.29
11. Because I feel guilty if I don't.	8.03	19.80	0.38
12. Because I feel bad about myself if I don't.	16.63	14.07	0.28
13. Because I feel lazy if I don't.	3.07	2.89	0.20
14. Because I need to do it to feel good about myself.	4.23	5.62	0.58
15. Because it makes me feel worthy as a person.	2.38	3.71	0.55
16. Because other people (e.g., parents, friends) get angry with me if I don't.	10.75	8.22	0.28
17. Because other people (e.g., parents, friends) get upset with me if I don't.	5.59	5.01	0.28
18. Because other people (e.g., parents, friends) tell me I should.	5.47	5.29	0.28
19. Because other people (e.g., parents, friends) force me to.	4.84	4.05	0.28
20. Because I feel under pressure from other people (e.g., parents, friends).	5.42	1.22	0.03
21. Because other people (e.g., parents, friends) pressure me.	4.29	3.68	0.28
24. And there may be good reason to, but I personally don't see any.	0.29	2.99	3.13
25. But I don't see why I should.	0.33	3.64	4.02
26. But I feel it is a waste of time.	0.40	3.20	3.35
27. But I don't see the point.	0.00	3.64	3.55
28. But I'm not sure if it's worth it.	0.57	2.94	3.38

Note. Effect sizes = Cohen's *d*. Retained items are bolded. Where all experts' rated the match between an item and a subscale the same (e.g., 1 poor match) and $SD = 0$, an effect size could not be calculated and is represented with a dash.

Phase 2: Initial Validity Evidence

Methods

The second phase of developing a measure is focused on determining the relationship between each item and each construct or latent variable (DeVellis, 2012). Because the purpose of the scale is to measure the three motivational constructs, in which a participant's score is based on their response to the individual items, it needs to be confirmed that the items do in fact relate to the intended construct, and the intended construct only (DeVellis, 2012). Therefore, factor analysis is used to determine the constructs which underlie the 16 items remaining from Phase I. Because the scale being developed is grounded in self-determination theory, and items are based on the three conceptual definitions, the purpose of the factor analysis in this Phase is to confirm the relationships between the items and the latent variables.

Participants. In order to conduct confirmatory factor analysis (CFA) on the MATSS scores, a convenience sample of 239 male adolescents aged 12-15 years ($M = 13.25$, $SD = 0.67$) from two non-government boys high schools in Sydney, Australia completed the 16-item MATSS. The only eligibility criterion was that students needed to have actively travelled to school at least once during the previous year. Ethics approval was received from the Western Sydney University Human Research Ethics Committee and the Australian Catholic University Human Research Ethics Committee (see Appendix C for approval letter). Parental consent and participant assent were obtained from each student (see Appendix F).

Measure. Before responding to any of the items, students read the following explanation of active travel. Active travel means that you travel at least part of your journey by: walking, cycling, scooter, skateboarding, or some other kind of physical activity. Active travel includes trips when only part of your journey was active. For

example, you might walk to catch a bus (Hardy et al., 2011; Merom et al., 2006). The MATSS then consisted of the stem “I actively travel to or from school...” which was followed by 16 short items (i.e., six items measuring autonomous motivation, five measuring controlled motivation, and five measuring amotivation). Participants then responded to each item on a 5-point Likert scale from *strongly disagree* = 1 to *strongly agree* = 5 (see Appendix G for MATSS instrument and scoring key).

Data Analysis. To account for the 1.54% of the MATSS data points missing, full information maximum likelihood estimation was used. To account for potential violations of multivariate normality, robust standard errors (MLR) were used. First, the factor structure of the full 16-item model was investigated using CFA in MPlus (version 7.4; Muthén & Muthén, 2016). However, as a briefer measure was desired, further items were removed based on low item-factor loadings (<.40), large standardized residuals (>2), or high modification indices (Marsh et al., 2005). Confirmatory factor analysis was again utilised to assess the construct validity of the revised model by testing whether the data fit the hypothesised three-factor model based on a self-determination theory framework (autonomous motivation, controlled motivation, amotivation). A comparative fit index (CFI) close to .95, a standardised root mean square residual (SRMR) $\leq .08$, and a root mean squared error of approximation (RMSEA) close to .06 indicate very good fit (Hu & Bentler, 1999). Interfactor correlations (i.e., correlations between the three motivation subscales) were also calculated to assess the nomological network (i.e., when stronger correlations exist between factors that lie closer together on the self-determination theory continuum). Finally, Raykov’s (1997) formula, $\rho = (\Sigma\lambda)^2 / [(\Sigma\lambda)^2 + (\Sigma\Theta)]$, where λ = item factor loadings and Θ = error terms, was used to assess composite reliability (i.e., internal consistency). Raykov’s ρ is similar to the commonly used Cronbach’s coefficient α (Cronbach, 1951), yet it uses a structural

equation model to estimate composite reliability and does not possess the tendency to underestimate reliability that is found with Cronbach's coefficient α (Raykov, 1997).

Results

Initial analysis of scores from the 16 items revealed poor fit of the data to the hypothesised three factor model (CFI = .83, SRMR = .10, RMSEA = .10). This was largely due to seven items cross loading onto both autonomous and controlled motivation subscales. These items also had the lowest factor loadings on their intended subscale. To reduce the length of the scale and increase the factorial validity of the MATSS scores, these seven items were removed from the model. The retained items measured the intended constructs (as indicated by strong factor loadings) and had minimal cross loadings (as indicated by low modification indices). A subjective evaluation of the three items retained in each subscale indicated that the nine items maintained the breadth of content of the 16-item model (Marsh et al., 2005). Analysis of the revised 9-item model showed good fit to the data ($\chi^2 = 47.71$, CFI = .95, SRMR = .07, and RMSEA = .06; Table 8). The factor loadings ranged from .57 to .87 for the autonomous motivation subscale, .36 to .99 for the controlled motivation subscale, and .69 to .87 for the amotivation subscale (Table 9). Negative interfactor correlations were found between autonomous and controlled motivation ($r = -.15$, $p = .03$) and between autonomous motivation and amotivation ($r = -.51$, $p < .001$), and a positive correlation was found between controlled motivation and amotivation ($r = .22$, $p < .01$). The composite reliability scores were $\rho = .77$ for the autonomous motivation subscale, $\rho = .61$ for controlled motivation, and $\rho = .83$ for amotivation.

Table 8

Goodness of Fit Statistics for the Revised 9-item Three Factor Model

	df	χ^2	Δdf	$\Delta \chi^2$	CFI	ΔCFI	RMSEA	$\Delta RMSEA$	SRMR
Initial Sample	36	47.71	-	-	.95	-	.06	-	.07
Cross Validation Sample	24	147.38	-	-	.95	-	.06	-	.06
Model 1 – Configural Measurement Invariance	48	169.10	-	-	.94	-	.07	-	.06
Model 2 - Metric Measurement Invariance	54	183.14	18	14.04	.94	.00	.06	.00	.07
Model 3 – Scalar Measurement Invariance	60	190.15	24	21.05	.94	.00	.06	.00	.07
Model 4 - Full Uniqueness Measurement Invariance	69	192.48	33	23.38	.94	.00	.06	.00	.07

Note. A dash indicates that a particular statistic was not applicable for that model. Invariance testing refers to gender invariance.

Table 9

Items, Factor Loadings, and Descriptive Statistics of the 9-item MATSS scores

Items	Initial Sample				Cross Validation Sample				
	<i>M</i>	<i>SD</i>	λ	Θ	<i>M</i>	<i>SD</i>	λ	Θ	
Autonomous Motivation									
1. Because I enjoy it	3.18	1.12	.87	.24	3.42	1.23	.81	.35	
2. Because it is interesting	2.91	1.13	.76	.43	3.11	1.23	.78	.39	
3. Because the benefits are important to me	3.36	1.16	.57	.68	3.44	1.26	.58	.67	
Controlled Motivation									
4. Because I feel guilty if I don't	2.01	0.96	.36	.87	2.11	1.14	.51	.75	
5. Because other people (e.g., parents, friends) get upset with me if I don't	1.97	1.13	.99	.02	1.91	1.18	.73	.47	
6. Because other people (e.g., parents, friends) tell me I should	2.69	1.24	.51	.74	2.42	1.32	.65	.58	
Amotivation									
7. But I don't see why I should	2.19	1.01	.69	.52	2.03	1.08	.67	.55	
8. But I feel it is a waste of time	2.14	1.07	.79	.38	1.91	1.09	.75	.43	
9. But I don't see the point	2.19	1.08	.87	.25	1.89	1.12	.81	.34	

Note. λ = item factor loading; Θ = error term.

Phase 3: Cross Validation

Methods

Participants. The 9-item MATSS was then administered alongside a measure of motivation towards leisure-time physical activity, to a sample of 1,447 participants (55% male and 45% female) aged 11-15 years ($M = 12.94$, $SD = 0.54$). These participants attended one of 14 co-educational government high schools located in an area of low socioeconomic status in Western Sydney, Australia. Ethics approval was received from the Western Sydney University Human Research Ethics Committee, the Australian Catholic University Human Research Ethics Committee, and the New South Wales Department of Education. Parental consent and participant assent were obtained from each student participating in the study (see Appendix H).

Measures.

Self-determined motivation towards active travel. Motivation towards active travel was measured by the 9-item MATSS (see Appendix G) which showed good fit to the data in Phase 2. Before responding to any of the items, students read the following explanation of active travel. Active travel to or from school means that you travel at least part of your journey by: walking, cycling, scooter, skateboarding, or some other kind of physical activity. Active travel includes trips when only part of your journey was active. For example, you might walk to catch a bus (Hardy et al., 2011; Merom et al., 2006). The MATSS then consisted of the stem “I actively travel to or from school...” followed by 9-items intending to measure autonomous motivation, controlled motivation, and amotivation (3-items per construct). Participants were asked to respond to each item on a 5-point Likert scale from *strongly disagree* = 1 to *strongly agree* = 5.

Self-determined motivation towards leisure-time physical activity. The Behavioural Regulation in Exercise Questionnaire (BREQ-2; see Appendix I) was used to measure motivation towards leisure-time physical activity. The BREQ-2 consisted of the stem “Why do you participate in sport and/or physical activity during your spare time?” and was followed by 19-items measuring intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation. Participants were asked to respond to each item on a 5-point Likert scale from *strongly disagree* = 1 to *strongly agree* = 5. Acceptable reliability and validity has been shown for BREQ-2 scores among adolescents (McDavid, Cox, & Amorose, 2012).

Data Analysis. With 1.14% of the data points missing, a maximum likelihood estimator with robust standard errors (MLR) was again used. First, a CFA model was conducted in MPlus (version 7.4; Muthén & Muthén, 2016) to assess the construct validity of scores on the same 9-item model from Phase 2. To test for gender invariance of the parameters within the MATSS model, a series of multiple group CFA models were carried out, as outlined by Muthén and Muthén (2010), where male and female students formed two separate groups. The baseline multiple group CFA model involved no parameter constraints (i.e., configural invariance), the second model constrained factor loadings to be equal between groups (i.e., metric invariance), the third constrained factor loadings and intercepts (i.e. scalar invariance), and the fourth model constrained factor loadings, intercepts, and residual variances (i.e., full uniqueness invariance). Measurement invariance was then assessed by comparing the fit statistics of each increasingly constrained model to the baseline model. A change in CFI > .01 from a less constrained to a more constrained model is indicative of worse fit and suggests that the model is not invariant on the newly constrained parameter (G. W. Cheung & Rensvold, 2002). Interfactor correlations (i.e., correlations between the three motivation

subscales) were then calculated to assess the nomological network, and Raykov's (1997) formula was used to assess composite reliability.

While an individual's motivation is not expected to be the same towards active travel and leisure-time physical activity, stronger positive correlations between matching factors (e.g., MATSS autonomous and BREQ-2 autonomous) compared to non-matching factors (e.g., MATSS autonomous and BREQ-2 amotivation) would indicate convergent validity (Cresswell & Eklund, 2006). As such, a multi-trait, multi-method approach was used to specify a CFA model that included both the MATSS factors (autonomous, controlled, and amotivation) and the BREQ-2 factors (intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation). In order to investigate the correlations between matching factors on both measures, two second order factors were included for the BREQ-2. First, the BREQ-2 intrinsic motivation and identified regulation subscales loaded onto the higher order factor – autonomous motivation, and the BREQ-2 introjected regulation and external regulation subscales loaded onto controlled motivation (as demonstrated in Figure 1, in Chapter 1). Finally, the residual variances of similar worded items on the BREQ-2 and MATSS were correlated. The correlations between the three MATSS factor scores and corresponding BREQ-2 factor scores were then examined.

Results

The data showed good fit to the 9-item model: $\chi^2 [24] = 147.38$, CFI = .95, SRMR = .06, RMSEA = .06 (Table 8). The factor loadings ranged from .58 to .81 for the autonomous motivation subscale, .51 to .73 for the controlled motivation subscale, and .67 to .81 for the amotivation subscale (Table 9). When considering factorial validity across gender, there was evidence of configural, metric, scalar, and full uniqueness invariance as all $\Delta \chi^2$ were non-significant ($p > .05$) and all Δ CFI were $< .01$

(see Table 8). Subscale reliability results for the MATSS scores were $\rho = .76$ for autonomous motivation, $\rho = .64$ for controlled motivation, and $\rho = .79$ for amotivation. The BREQ-2 model also showed good fit to the data (CFI = .93, SRMR = .05, RMSEA = .06), as did the multi-trait multi-method model including the MATSS and BREQ-2 scores (CFI = .94, SRMR = .05, RMSEA = .05).

The full correlation matrix among all MATSS and BREQ-2 factors is presented in Table 10. Among the MATSS subscales, autonomous motivation and amotivation were negatively correlated ($r = -.40$), while controlled motivation and amotivation were positively correlated ($r = .44$), as were autonomous and controlled motivation ($r = .20$). This pattern of correlations suggests divergent validity as the nomological network is in line with the ordered nature of the motivational constructs along the self-determination theory continuum. Correlations between matching factors (e.g., MATSS autonomous and BREQ-2 autonomous) were positive and the average correlation between matching factors ($r = .63$) was higher than the average correlation between non-matching factors ($r = .05$) suggesting convergent validity.

Table 10

Correlation Matrix between Motivation Factors

	Mean	SD	MATSS autonomous	MATSS controlled	MATSS amotivation	BREQ-2 autonomous	BREQ-2 controlled
MATSS autonomous motivation	3.33	1.03					
MATSS controlled motivation	2.15	0.93	.20***				
MATSS amotivation	1.95	0.92	-.40***	.44***			
BREQ-2 autonomous motivation	3.52	0.87	.60***	.02	-.35***		
BREQ-2 controlled motivation	2.34	0.85	.30***	.68***	.25***	.48***	
BREQ-2 amotivation	1.68	0.85	-.13***	.30***	.61***	-.55***	.29***

Note. Boldface correlations represent matching factors across the MATSS and BREQ-2. BREQ-2 = Behavioural Regulation in Exercise Questionnaire-2; MATSS = Motivation towards Active Travel to School Scale.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Discussion

The purpose of this study was to develop a brief measure of motivation towards active travel to and from school, and to assess the psychometric properties of this new scale among adolescents. The item content-validity coefficients and effect sizes showed that the items were related to their intended construct only, providing evidence of content validity, and the good fit of the data to the hypothesised three-factor model supported the factorial validity of the MATSS scores. Given that the three subscales each measure a broad construct with only three items per construct, the ρ values ($\geq .64$) are likely to demonstrate acceptable composite reliability of the MATSS scores (Raykov, 2012). The MATSS scores were also invariant across gender. Further, the interfactor correlations showed that the three motivational subscales were correlated in an ordered manner that is consistent with the tenets of self-determination theory. More specifically, stronger positive correlations were found between motivational constructs that lie closer together (e.g., controlled motivation and amotivation) compared to those that are further apart (e.g., autonomous motivation and amotivation), supporting the nomological validity of the MATSS scores (Messick, 1980). Finally, the strong positive correlations between the MATSS factors and corresponding BREQ-2 factors suggested convergent validity (Cresswell & Eklund, 2006).

Self-determination theory may provide a valuable approach to understanding and, eventually, promoting active travel to school among adolescents. Further research should investigate the relationship between different forms of motivation and active travel behaviour, with particular focus on those who are least likely to meet physical activity recommendations, including girls and students from low socioeconomic areas (Hallal, Victora, Azevedo, & Wells, 2006). If motivation appears to be a determinant of active travel in these populations then finding ways to enhance motivation towards

active travel could be of particular benefit to increasing daily physical activity participation. Future research should also investigate the role of self-determined motivation as a moderator variable, as motivation could influence the effect of active travel on psychological and educational outcomes such as positive affect and school engagement following the trip to school. If students actively travel to school but do so because of controlled motivation or amotivation, they may participate in increased amounts of physical activity, but may not receive the same beneficial outcomes as students who are autonomously motivated to walk or ride to school (Asztalos et al., 2009; Gagné & Deci, 2005).

Strengths and Limitations

This is the first study to provide validity and reliability evidence for scores derived from a measure of adolescents' motivation towards active travel to and from school. Strengths of this study include the expert review of the initial item pool and the large cross validation sample enabling gender invariance to be confirmed. Another strength is the brevity of the scale (i.e., nine items). A shorter questionnaire requires less effort and is associated with better quality responses, particularly among adolescents (Ganassali, 2008). Further, a brief scale is advantageous given the increasing need to administer multiple instruments within a single study (Goetz et al., 2013). Some limitations should also be noted. The MATSS was specifically developed to understand adolescents' motivation towards active travel to school. As such, the psychometric properties of the MATSS scores were only examined in a sample from this population. Nevertheless, the structure of the MATSS could be used to guide the development of a measure of motivation towards active travel to and from work among adults, and active travel during leisure-time (e.g., walking to the shops or a friend's house). Additionally, items measured the three broader constructs of motivation (i.e., autonomous motivation, controlled motivation, and amotivation), rather than separate subscales for each

regulation (i.e., intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation). While the reason for only including the three broader subscales was to ensure the scale was brief and could be administered within a wider test battery, it means the MATSS cannot be used to examine fine-grained distinctions between motives that fall within a broader category of motivation (e.g., the influence of introjected vs external regulation on active travel behaviour).

Conclusions

This study provides evidence for the validity and reliability of the MATSS scores among adolescents. The MATSS could be used to investigate motivational antecedents and outcomes associated with active travel to school. Not only could this research lead to more effective methods of promoting active travel among adolescents, but it could also provide insights into the potential benefits of autonomously motivated active travel on students' health and wellbeing.

Synopsis

This chapter outlined the methodological steps of developing a measure of motivation towards active travel, and presented findings relating to the validity of scores derived from the measure. This chapter also highlighted potential uses for such a measure, including the testing of motivation as a moderator of the relationship between physical activity and mental wellbeing. The following chapter will present such a study.

CHAPTER 5: Moderator Analyses

Domain-specific physical activity and affective wellbeing among adolescents: The role of self-determined motivation

Abstract

Objective: The relationship between physical activity and mental wellbeing is not consistent across different life domains. However, the factors which influence these relationships and contribute to variation, both within and between different domains, are not well understood. The purpose of this study was to examine whether motivation moderates the relationships between physical activity and affective wellbeing within two different domains (i.e., leisure-time and active travel).

Methods: A sample of 1,632 adolescents (M age = 12.94 years, SD = 0.54, 55% male) completed self-report measures of leisure-time physical activity and active travel. Participants also wore an accelerometer across seven days in order to objectively measure domain-specific physical activity. Participants also completed two measures of motivation – one towards leisure-time physical activity and one towards active travel – as well as a measure of affective wellbeing (i.e., positive and negative affect).

Results: Structural equation modelling revealed that greater self-reported leisure-time physical activity was associated with greater positive affect ($\beta = .29$) and less negative affect ($\beta = -.19$), while self-reported active travel had no relationship with positive ($\beta = -.06$) or negative affect ($\beta = .00$). However, the relationship between active travel and affective wellbeing was significantly moderated by motivation. Active travel had a positive association with negative affect when controlled motivation was higher ($\beta = .12$), but a negative association when controlled motivation was lower ($\beta = -.10$). A similar relationship was found among the objective active travel measure. Active travel

had a positive association with positive affect if autonomous motivation was high ($\beta = .05$), that was significantly different from the relationship observed when autonomous motivation was low ($\beta = -.11$).

Conclusions: Tailoring interventions and physical activity guidelines to focus on leisure-time physical activity could be beneficial. However, promoting autonomous participation in physical activity outside leisure-time may also be associated with increased mental wellbeing among adolescents.

Introduction

Mental health disorders are associated with low self-esteem, the inability to maintain interpersonal relationships, and a higher risk of cardiovascular disease and cancer (Lawrence et al., 2013; M. Prince et al., 2007; Whiteford et al., 2013; World Health Organization, 2001). The impact of mental health disorders is so extensive that a 14-year gap in life expectancy exists between those with a mental health disorder and the general population (Lawrence et al., 2013). Alarming, 32% of adolescents experience an anxiety disorder (Merikangas et al., 2010) and 29% experience depression (Hume et al., 2011). Not only is positive mental wellbeing a protective factor against the onset of a mental health disorder (Saxena et al., 2006), but it is also associated with self-esteem; and the ability to maintain positive interpersonal relationships, work productively, and contribute to society (Herrman et al., 2005).

Abundant evidence shows that participating in physical activity is associated with increased mental wellbeing. Physical activity involves any muscular movement which requires energy (Shephard, 2003) and, therefore, includes a large variety of behaviours which may take place in a number of different life domains, such as leisure-time, work, school, transport, and household duties. Importantly, the relationship between physical activity and mental wellbeing is not consistent across these different

life domains, with evidence showing that in comparison to other domains, leisure-time physical activity has a stronger positive relationship with mental wellbeing (Cerin et al., 2009), and a stronger inverse relationship with depression (Teychenne et al., 2010) and stress (Asztalos et al., 2009). Additionally, studies show that the relationship between physical activity and mental wellbeing also varies within some domains, particularly active travel and household physical activity (Asztalos et al., 2009; Cerin et al., 2009). For example, Asztalos et al. (2009) showed that active travel was detrimental to mental health among blue collar workers, but not among white collar workers. Similarly, Cerin et al. (2009) showed that household physical activity was detrimental to mental health among young people, but beneficial to mental health among older adults. Additionally, household physical activity was associated with lower mental wellbeing among those who participate in large amounts of work-related physical activity, compared to those who do not (Cerin et al., 2009).

Motivation towards physical activity may be one factor that influences the relationship between physical activity and mental wellbeing. Self-determination theory (Deci & Ryan, 1985) posits that the degree to which a behaviour is autonomously motivated, influences the effect of that behaviour on mental wellbeing, such that, more autonomously motivated behaviours provide greater benefits to mental wellbeing. As such, behaviours which are autonomously motivated are associated with more positive psychological outcomes than behaviours which are undertaken due to controlled motivation (Deci & Ryan, 2008a). Autonomously motivated behaviours are those in which an individual acts with volition and choice because they find the activity enjoyable or personally important (Williams, 2002), while controlled motivation refers to engaging in an activity due to internal pressure such as guilt, or external incentives such as rewards or enforcement (Gillet et al., 2012).

Compared to other life domains, in particular work, leisure-time is more likely to inherently provide individuals with autonomy over how they spend their time (Asztalos et al., 2009). Additionally, many leisure-time activities are likely to be more enjoyable than physical activity not during leisure-time, such as active travel, household physical activity, or work-related physical activity (Asztalos et al., 2009). Therefore, it seems plausible that people would be more autonomously motivated towards leisure-time physical activity than other domains. Given that leisure-time physical activity consistently benefits mental wellbeing, and physical activity in other domains such as work-related physical activity can be detrimental (Kull et al., 2012), it seems likely that motivation towards physical activity may play a role.

Although physical activity that is not undertaken in leisure-time may be motivated by an obligatory or controlling agency, such as pay in the workplace or parental control in terms of active travel (Asztalos et al., 2009), the degree to which individuals are autonomously motivated may vary. This concept could be particularly important for explaining the relationship between active travel and mental wellbeing, as evidence appears contradictory in terms of whether active travel is beneficial or not (Jurakić et al., 2010; Purakom et al., 2014). Asztalos et al. (2009) found that active travel to work was detrimental to mental health among blue collar workers, but not white collar workers. They suggested that motivation towards transport physical activity may explain such a finding. For example, individuals who own a car but choose to walk for health benefits are self-determined. Alternatively, individuals who ride their bike to work for financial reasons such as not owning a car, do so for reasons external to the self and do not experience psychological benefits; rather the activity is associated with increased stress. As such, motivation towards physical activity may explain some of the variation in the relationship between active travel and mental wellbeing. This idea may also be true for adolescents; students who walk to school because they enjoy it may

experience more positive psychological outcomes than those who are forced to walk by their parents.

Understanding why physical activity during specific domains improves wellbeing for some individuals and not others is an important endeavour; however, no study has employed a self-determination theory framework to examine the potential role of motivation. As such, the primary purpose of this study was to investigate whether motivation moderated the relationships between domain-specific physical activity (i.e., leisure-time physical activity and active travel) and the affective component of wellbeing (i.e., positive affect and negative affect) among adolescents.

Methods

Participants

Data were collected from 14 government high schools in Western Sydney, Australia, in 2014, as part of the Activity and Motivation in Physical Education (AMPED) cluster randomised controlled trial (Lonsdale, Lester, et al., 2016). All 14 schools were located in a postcode with a low socioeconomic status (i.e., geographical areas with reduced access to social and material resources and a lower ability for individuals to contribute to their society, relative to other geographical locations) (Australian Bureau of Statistics, 2006). All Year 8 students completing baseline measurements at both intervention and waitlist control schools were invited to participate; only those with an injury or medical issue preventing their participation in physical activity were excluded. The total sample included 1,632 students (55% male and 45% female) whose ages ranged from 11 to 15 years ($M = 12.94$, $SD = 0.54$). Ethical approval was received from the Western Sydney University and Australian Catholic University Human Research Ethics Committees and the New South Wales

Department of Education. All participating students provided parental consent and participant assent (see Appendix H).

Procedures

Students completed all questionnaires during one scheduled lesson at school. After completing the questionnaire, participants observed the correct positioning of the accelerometer, received an accelerometer, and were instructed to wear the device for all waking hours, excluding water-based activities and contact sports, for the following seven days. Students also received a text message reminder each morning to encourage them to wear the device. During this seven-day period participants also completed a travel diary during two scheduled lessons two days apart.

Measures

Active travel physical activity. Active travel refers to any physically active mode of transport to or from school (e.g., walking, cycling, scooter, or skateboarding) (Hardy et al., 2011; Merom et al., 2006). Accelerometers (ActiGraph GT3X+) were worn on participants' right hip via a cotton elastic belt in order to directly measure movement (i.e., objectively measure moderate-to-vigorous physical activity) during participants' travel to and from school. While accelerometers are capable of providing an objective record of physical activity, the domain in which physical activity is conducted cannot be determined from the accelerometer data alone. Therefore, the students also completed a 48-hour recall travel diary (see Appendix J) that included reporting the time the students left home and arrived at school in the morning, and left school and arrived at home in the afternoon. These student-reported times were imported into accelerometer processing software (ActiLife) to calculate moderate-to-vigorous physical activity during students' travel to and from school, as measured by accelerometer. However, even objective measures of physical activity include bias

particularly if students ride to school as opposed to walk (Welk, 2002). As such, the travel diary also included self-reporting mode of travel which was used as a self-report measure of active travel. The travel diary was similar to a previously validated travel diary which used a 24-hour recall period for younger students (McMinn, Rowe, Murtagh, & Nelson, 2011).

Leisure-time physical activity. Leisure-time physical activity was defined as physical activity outside school hours, excluding travel to and from school. As such, each participant's school bell times were recorded, and both the school period and travel period were filtered out of the total physical activity data to calculate moderate-to-vigorous physical activity during leisure-time.

Although objective measures of leisure-time physical activity do not include the same recall and social desirability issues that self-report measures do, they still include measurement error as they cannot detect upper-arm movements and water-based activities (Welk, 2002). Therefore, the students also completed an adapted version of the WHO Health Behaviour in School-aged Children (HBSC) measure of physical activity (see Appendix K) which was used as a self-report measure of leisure-time physical activity. Acceptable reliability and validity has been reported for the HBSC physical activity scores in a sample of Year 8 students in NSW, Australia (Booth, Okely, Chey, & Bauman, 2001).

Self-determined motivation towards active travel. The Motivation towards Active Travel to School Scale (MATSS) was used to measure self-determined motivation towards active travel to and from school. The MATSS consisted of the stem "I actively travel to or from school..." and was followed by 9-items measuring autonomous motivation, controlled motivation, and amotivation. Participants responded to each item on a 5-point Likert scale, where *strongly disagree* = 1 and *strongly agree* =

5. The MATSS showed acceptable reliability and validity among adolescents from Western Sydney, Australia, in Chapter 4.

Self-determined motivation towards leisure-time physical activity. The Behavioural Regulation in Exercise Questionnaire (BREQ-2) was employed to measure motivation towards leisure-time physical activity. The BREQ-2 consisted of the stem “Why do you participate in sport and/or physical activity during your spare time?” and was followed by 19-items measuring intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation. The BREQ-2 intrinsic motivation and identified regulation subscales loaded onto the higher order factor – autonomous motivation, and the BREQ-2 introjected regulation and external regulation subscales loaded onto controlled motivation. Participants were asked to respond to each item on a 5-point Likert scale from *strongly disagree* = 1 to *strongly agree* = 5. Acceptable reliability and validity has been shown for the 5-factor BREQ-2 model among adolescents (Markland & Tobin, 2004; McDavid et al., 2012), and data from this thesis supported using the BREQ-2 broader constructs (i.e., autonomous motivation, controlled motivation, and amotivation; see Chapter 4).

Positive and negative affect. The short version of the Positive and Negative Affect Scale (D. Watson et al., 1988) consists of the instruction “indicate to what extent you have felt this way during the past few weeks” and is followed by 10 items; five measure positive affect and five measure negative affect (see Appendix L). Participants responded to each item on a 5-point Likert scale from *very slightly* = 1 to *extremely* = 5. The Positive and Negative Affect Scale has been previously validated among adolescents (Ebesutani et al., 2012).

Covariates. Evidence shows that physical activity participation is inversely associated with body mass index and age, and positively associated with socioeconomic status (Salvo et al., 2015). Additionally, males tend to participate in higher amounts of

physical activity than females (Troost et al., 2002). Furthermore, a higher body mass index and a lower socioeconomic status are also associated with a higher risk of mental ill-health (McCrea, Berger, & King, 2012; Reiss, 2013). As such, socioeconomic status was measured using the adapted Family Affluence Scale (Boyce, Torsheim, Currie, & Zambon, 2006), and age, sex, height, and weight were also measured.

Data Preparation

To prepare the accelerometer data, wear-time files were created. Wear-time files consisted of a count-value for each 1-second epoch of data, but excluded periods of ≥ 60 minutes of consecutive zero counts, allowing for a 1-2 minute spike tolerance of 0-100 counts per minute (Troiano et al., 2008). The “Log Diaries” function in ActiLife was then used to specify the time periods to be analysed for each participant (i.e., leisure-time and active travel). Within each domain, each 1-second epoch count-value based on the intensity of raw acceleration was categorised into its corresponding intensity of physical activity (i.e., sedentary, light, moderate, or vigorous) based on Evenson’s (2008) equations for children between six and 18 years of age. This process enabled the calculation of moderate-to-vigorous physical activity within each domain. Finally, data was checked for any students who provided the same response on all items within a particular questionnaire; however, no such students were identified and, therefore, no students’ responses were removed.

Data Analysis

First, Pearson product-moment correlations were calculated to examine the relationships between all variables. Next, structural equation modelling was employed to test the hypothesised relationships between domain-specific physical activity (independent variables) and affective wellbeing (dependent variables). First, the paths between the physical activity variables and the two affect factors were estimated.

Second, corresponding paths (e.g., leisure-time physical activity on positive affect and active travel on positive affect) were constrained to be equal and a Wald chi-square test was conducted to determine if the path coefficients for the two physical activity domains (i.e., leisure-time physical activity and active travel) were significantly different from each other. Full information maximum likelihood was used to account for missing data and cluster robust standard errors were employed to account for non-normality and to account for the complex nature of the data (students nested within schools).

Next, latent variable moderation analyses were conducted in MPlus (version 7.4; Muthén & Muthén, 2016) to evaluate whether motivational constructs (i.e., autonomous motivation and controlled motivation) moderated the relationships between domain-specific physical activity and affective wellbeing. As shown in Figure 5, the physical activity variables, the motivation variables, and the interaction terms were regressed onto the outcome variables (i.e., positive affect and negative affect). Again, corresponding paths were constrained to be equal and a Wald chi-square test was conducted. This procedure was first conducted using autonomous motivation towards each physical activity domain, and then repeated using controlled motivation. Finally, the same models were specified again, but adjusting for age and sex.

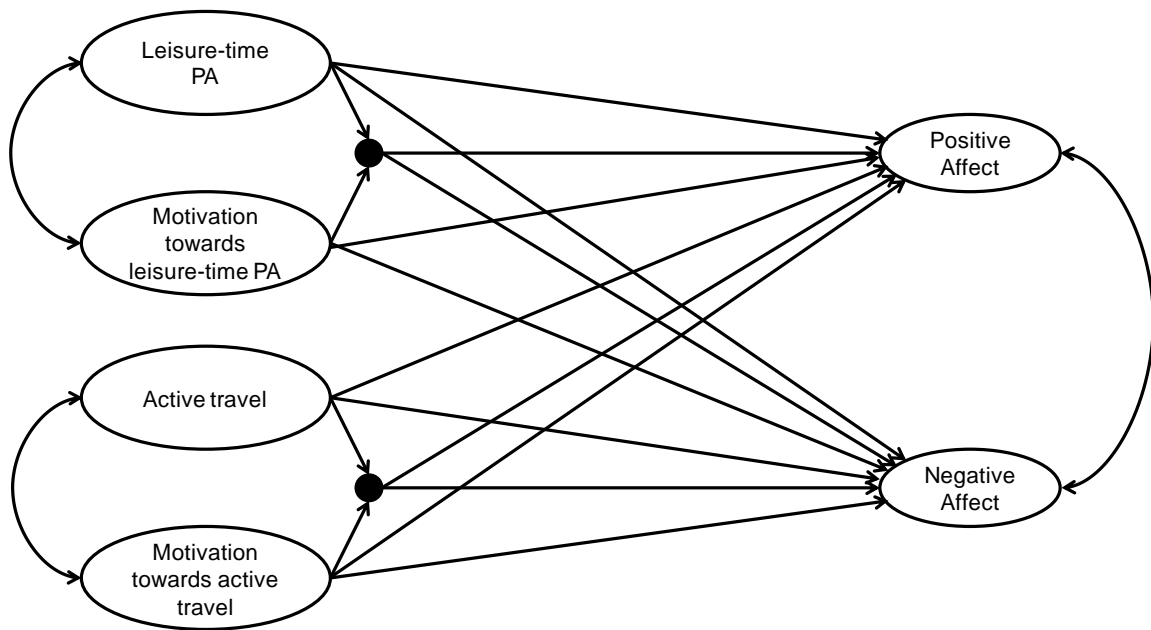


Figure 2. Diagram of structural equation model testing moderation.

Results

Active Travel

The correlations among all variables are shown in Table 11. Little support was found for a linear relationship between active travel and affective wellbeing. As shown in Table 12, objectively measured active travel had a small significant negative association with negative affect ($\beta = -.11$). However, objectively measured active travel was not associated with positive affect. Self-report active travel was not associated with either positive affect or negative affect.

Table 11

Correlations between Physical Activity, Affect, and Motivation

Variable	M	SD	Positive Affect	Negative Affect	Leisure-time PA self-report	Active Travel self-report	Leisure-time PA objective	Active Travel objective	BREQ-2 autonomous	BREQ-2 controlled	BREQ-2 amotivation	MATSS autonomous	MATSS controlled
Positive Affect	3.64	0.89											
Negative Affect	1.89	0.84	-.33***										
Leisure-time PA: self-report	3.41	1.20	.25***	-.15***									
Active Travel: self-report	0.50	0.43	-.04	-.00	.06								
Leisure-time PA: objective	0.05	0.05	.05	-.10***	.18***	.01							
Active Travel: objective	0.22	0.17	-.04	-.12***	-.08	-.00	.11						
BREQ-2 autonomous	3.52	0.87	.47***	-.10**	.53***	.04	.05	.00					
BREQ-2 controlled	2.34	0.85	.07	.35***	.10	-.02	-.06	-.04	.31***				
BREQ-2 amotivation	1.68	0.85	-.16***	.26***	-.26***	.01	.01	.01	-.50***	.28***			
MATSS autonomous	3.33	1.03	.43***	.02	.21***	-.04	.02	-.03	.53***	.27***	-.15***		
MATSS controlled	2.15	0.93	.01	.28***	-.08	-.07	.05	.03	.03	.65***	.33***	.23***	
MATSS amotivation	1.95	0.92	-.19***	.25***	-.23***	.00	-.02	.00	-.33***	.25***	.61***	-.40***	.43***

Note. BREQ = Behavioural Regulation in Exercise Questionnaire; MATSS = Motivation towards Active Travel to School Scale; PA = physical activity. Affect and motivation were both measured on a Likert scale from 1-5.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 12

Relationships between Domain-Specific Physical Activity and Affect

	Self-report		Objective	
	Leisure-time PA (β)	Active Travel (β)	Leisure-time PA (β)	Active Travel (β)
Positive Affect	.29*** ^a	-.06 ^b	.05	-.06
Negative Affect	-.19***	.00	-.09*	-.11***

Note. PA = physical activity.

^a is significantly different to ^b ($p < .001$).

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 13 shows, however, that the interaction between self-report active travel and controlled motivation significantly moderated ($\beta = .11, p < .01$) the relationship between self-report active travel and negative affect. More specifically, for students one *SD* above the mean on controlled motivation, the relationship between self-report active travel and negative affect was positive ($\beta = .12$). Alternatively, among adolescents one *SD* below the mean on controlled motivation, the relationship between self-report active travel and negative affect was negative ($\beta = -.10$). However, the interaction between objectively measured active travel and controlled motivation was not significant for negative affect. The interaction between active travel and controlled motivation was also not significant for positive affect, regardless of whether active travel was measured objectively or via self-report.

As shown in Table 14, the interaction between objectively measured active travel and autonomous motivation moderated ($\beta = .08, p < .01$) the relationship between objectively measured active travel and positive affect. More specifically, for students one *SD* above the mean on autonomous motivation, a positive relationship was present between objectively measured active travel and positive affect ($\beta = .05$), whereas a negative relationship was identified between objectively measured active travel and positive affect for those one *SD* below the mean ($\beta = -.11$). However, this relationship

was not observed for self-reported active travel. The interaction between objectively measured active travel and autonomous motivation was also not significant for negative affect.

Table 13

Structural Equation Modelling Results Demonstrating whether Motivation Moderates the Relationship between Self-reported Domain-Specific Physical Activity and Affect

	Unadjusted model				Adjusted for age and sex				Fully adjusted model			
	β	SE	p	R ²	β	SE	p	R ²	β	SE	p	R ²
Model 1 – Autonomous motivation												
<i>Positive Affect</i>												
Leisure-time PA	-.00	.10	.98		-.08	.11	.48		-.05	.11	.68	
Active travel	-.05	.03	.16		-.05	.03	.10		-.05	.04	.16	
Autonomous motivation towards leisure-time PA	.38	.10	<.001		.44	.11	<.001		.37	.11	<.001	
Autonomous motivation towards active travel	.21	.06	<.001		.19	.07	.01		.27	.08	<.001	
Leisure-time PA × Autonomous Motivation	.06	.06	.35		.09	.06	.14		.09	.08	.25	
Active Travel × Autonomous Motivation	.00	.03	.95		.01	.02	.72		-.02	.03	.41	
				.28***				.31***				.28***
<i>Negative Affect</i>												
Leisure-time PA	-.15	.08	.06		-.14	.09	.13		-.08	.08	.26	
Active travel	.00	.03	.87		.01	.03	.78		.02	.03	.54	
Autonomous motivation towards leisure-time PA	-.07	.07	.30		-.08	.09	.38		-.16	.06	.01	
Autonomous motivation towards active travel	.05	.07	.47		.05	.09	.54		.02	.11	.83	
Leisure-time PA × Autonomous Motivation	-.01	.04	.76		-.00	.03	.92		-.00	.05	.96	
Active Travel × Autonomous Motivation	.01	.04	.73		.02	.04	.71		.08	.05	.13	
				.04*				.04*				.06*
Model 2 – Controlled Motivation												
<i>Positive Affect</i>												
Leisure-time PA	.30	.07	<.001		.24	.08	.004		.22	.08	.01	
Active travel	-.05	.03	.07		-.04	.03	.16		-.04	.03	.16	
Controlled motivation towards leisure-time PA	-.01	.08	.91		.05	.08	.49		.03	.08	.72	
Controlled motivation towards active travel	.11	.11	.34		.02	.09	.81		.02	.09	.82	
Leisure-time PA × Controlled Motivation	.06	.03	.06		.12	.07	.09		.06	.07	.39	
Active Travel × Controlled Motivation	-.07	.05	.17		-.04	.06	.48		-.05	.06	.42	
				.10*				.09**				.07*
<i>Negative Affect</i>												
Leisure-time PA	-.21	.06	<.001		-.17	.08	.03		-.12	.09	.16	
Active travel	.01	.02	.59		-.01	.03	.76		.01	.03	.60	
Controlled motivation towards leisure-time PA	.30	.09	<.001		.26	.08	<.001		.18	.10	.08	
Controlled motivation towards active travel	-.08	.10	.38		-.06	.09	.50		.00	.10	.99	
Leisure-time PA × Controlled Motivation	-.13	.08	.09		-.14	.07	.05		-.09	.08	.25	
Active Travel × Controlled Motivation	.11	.03	<.001		.08	.04	.07		.07	.03	.05	
				.18**				.14*				.11**

Note. PA = physical activity. All physical activity measures were self-reported. Fully adjusted model includes age, sex, socioeconomic status, and body mass index as covariates.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 14

Structural Equation Modelling Results Demonstrating whether Motivation Moderates the Relationship between Objectively Measured Domain-Specific Physical Activity and Affect

	Unadjusted model				Adjusted for age and sex				Fully adjusted model			
	β	SE	<i>p</i>	<i>R</i> ²	β	SE	<i>p</i>	<i>R</i> ²	β	SE	<i>p</i>	<i>R</i> ²
Model 1 – Autonomous motivation												
<i>Positive Affect</i>												
Leisure-time PA	-.01	.04	.76		-.04	.05	.42		-.00	.04	.94	
Active travel	-.03	.04	.48		-.02	.04	.61		-.02	.04	.70	
Autonomous motivation towards leisure-time PA	.42	.06	<.001		.44	.06	<.001	▫	.39	.07	<.001	
Autonomous motivation towards active travel	.04	.07	.54		.03	.08	.69		.06	.12	.62	
Leisure-time PA × Autonomous Motivation	.02	.03	.59		-.00	.03	.91		.02	.02	.43	
Active Travel × Autonomous Motivation	.08	.03	.01		.09	.04	.01		.10	.04	.02	
				.30***				.30***				.31***
<i>Negative Affect</i>												
Leisure-time PA	-.08	.04	.08		-.04	.05	.40		-.05	.04	.33	
Active travel	-.11	.03	<.001		-.10	.03	<.001		-.09	.03	<.001	
Autonomous motivation towards leisure-time PA	-.17	.06	<.001		-.13	.09	.12		-.10	.09	.27	
Autonomous motivation towards active travel	.18	.05	<.001		.17	.09	.08		.18	.12	.11	
Leisure-time PA × Autonomous Motivation	-.01	.04	.86		-.03	.05	.55		-.03	.05	.46	
Active Travel × Autonomous Motivation	-.04	.03	.14		-.04	.03	.25		-.06	.04	.14	
				.05***				.04**				.06***
Model 2 – Controlled Motivation												
<i>Positive Affect</i>												
Leisure-time PA	.06	.06	.32		.02	.05	.63		.04	.05	.50	
Active travel	-.06	.04	.15		-.04	.04	.25		-.05	.04	.27	
Controlled motivation towards leisure-time PA	-.05	.14	.75		-.09	.14	.50		-.09	.14	.53	
Controlled motivation towards active travel	.01	.18	.95		.02	.19	.90		-.03	.18	.87	
Leisure-time PA × Controlled Motivation	.04	.08	.62		.10	.06	.09		.08	.07	.28	
Active Travel × Controlled Motivation	-.01	.06	.87		-.02	.08	.75		-.00	.07	.97	
				.01				.05***				.03*
<i>Negative Affect</i>												
Leisure-time PA	-.08	.04	.05		-.11	.04	.01		-.04	.05	.42	
Active travel	-.11	.03	<.001		-.11	.03	<.001		-.09	.02	<.001	
Controlled motivation towards leisure-time PA	.22	.14	.13		.26	.14	.07		.18	.15	.22	
Controlled motivation towards active travel	.15	.18	.43		.10	.17	.57		.06	.17	.74	
Leisure-time PA × Controlled Motivation	.03	.06	.61		-.01	.05	.90		.02	.05	.71	
Active Travel × Controlled Motivation	-.03	.05	.63		-.02	.05	.74		.01	.05	.79	
				.14***				.13***				.10**

Note. PA = physical activity. All physical activity measures were objectively measured. Fully adjusted model includes age, sex, socioeconomic status, and body mass index as covariates.

p* < .05, *p* < .01, ****p* < .001.

Leisure-time Physical Activity

As highlighted in Table 12, self-report leisure-time physical activity had a moderate positive association with positive affect ($\beta = .29$) and a small-to-moderate inverse association with negative affect ($\beta = -.19$). Objectively measured leisure-time

physical activity was also inversely associated with negative affect ($\beta = -.09$), but no significant relationship was found between objectively measured leisure-time physical activity and positive affect.

As shown in Table 13 and Table 14, no interaction between leisure-time physical activity and autonomous motivation was significant for positive affect ($\beta = .06$ for self-report and $\beta = .02$ for objectively measured) or negative affect ($\beta = -.01$ for both objectively measured and self-report). The interactions between leisure-time physical activity and controlled motivation were also not significant ($p > .05$) for positive affect ($\beta = .06$ for self-report and $\beta = .04$ for objectively measured) or negative affect ($\beta = -.13$ for self-report and $\beta = .03$ for objectively measured). As such, the relationships between leisure-time physical activity and affective wellbeing were not moderated by motivation.

Discussion

This study showed that leisure-time physical activity was a stronger predictor of affective wellbeing than active travel. This finding is consistent with previous studies that have shown – in comparison to active travel – leisure-time physical activity is more strongly associated with reduced depression (Teychenne et al., 2010) and negative affect (McKercher, Schmidt, Sanderson, Dwyer, & Venn, 2012), and increased mental wellbeing (Cerin et al., 2009). However, this study showed that when adolescents participate in active travel because of autonomous motivation, active travel is associated with mental wellbeing. Given that controlled motivation thwarts an individual's need for autonomy, which is essential for optimal wellbeing (Deci & Ryan, 2000), it is not surprising that those who actively travel to school because they feel pressured or forced do not receive the same psychological benefits as those who autonomously choose to walk. However, it was alarming to find that controlled motivation not only prevents

physical activity from being associated with wellbeing, but it contributes to active travel being associated with increased negative affect.

According to self-determination theory, the reason that motivation influences mental wellbeing is because autonomous motivation is often associated with activities that satisfy individuals' basic psychological needs (Deci & Ryan, 2000), and according to basic psychological needs theory, the satisfaction of needs is associated with optimal wellbeing (Deci & Ryan, 2002a). Perhaps students who are autonomously motivated, walk to school with their peers or experience a sense of competence from the activity they have undertaken or the ability to be independent and travel without the need of a parent. Whereas, adolescents who walk to school because they are forced or pressured experience poor satisfaction of their psychological needs, and therefore, do not receive psychological benefits (Deci & Ryan, 2002a). However, not only is it likely that their needs for competence and relatedness are not satisfied, but their need for autonomy is likely to be thwarted (Deci & Ryan, 2002a). As such, even if a student's need for competence or relatedness is satisfied through active travel, the thwarting of their need for autonomy – and the stress and pressure that accompanies such control – may undermine any psychological benefits that would arise if they actively travelled for more autonomous reasons (Vansteenkiste et al., 2004). Examining the satisfaction or thwarting of each psychological need could be useful in understanding how to promote autonomous motivation and reduce controlled motivation, in order to improve the effect of active travel on mental wellbeing.

Understanding why the same moderation effect does not occur for leisure-time physical activity is also important. Perhaps, leisure-time innately provides adolescents with perceived choice over the way in which they spend their time. Therefore, those who are autonomously motivated towards leisure-time physical activity participate in

larger amounts of leisure-time physical activity. Alternatively, those who are controlled or amotivated participate in less leisure-time physical activity, and so their motivation influences the amount of physical activity they undertake rather than any relationship between the activity and affective wellbeing. The relationship between motivation and behaviour, however, is very different within the active travel domain. Autonomous motivation is not associated with increased active travel, nor is controlled motivation associated with significantly less active travel. As such, many students actively travel despite controlled motivation and many travel passively despite autonomous motivation to walk. Given that students have little control over their participation in active travel and are often forced to walk (Cycling Promotion Fund, 2012), motivation does not influence the amount of active travel, but rather, influences whether the behaviour is associated with positive or negative affect. Furthermore, a large portion of adolescents' leisure-time physical activity is likely to include participation in an organised sport where skills are learnt with teammates and peers (Active Healthy Kids Australia, 2014). Consequently, many individuals may experience competence and relatedness when participating in leisure-time physical activity even if motivation is controlled. As a result, leisure-time physical activity may remain consistently beneficial despite poor quality motivation for some.

Perhaps leisure-time physical activity is inherently associated with the satisfaction of autonomy and, therefore, is consistently associated with positive affect. However, motivation becomes a more important factor within other domains where perceived choice is not as inherent, such as active travel, and potentially work-related physical activity, household physical activity, and school-based physical activity. In these domains, ensuring activities are enjoyable, optimally challenging, and promote a sense of belonging, could shift people's locus of control to a more internal focus and result in more autonomous motivation and increased affective wellbeing, despite

originally participating for controlled reasons (Biddle & Mutrie, 2015). Enhancing people's autonomous motivation could then protect them from the detrimental effects of participating in physical activity that is not inherently enjoyable.

Given that self-reported leisure-time physical activity had a stronger positive association with affective wellbeing, it is important to consider why this may be the case, and what it informs about the relationship between physical activity and mental health. There are unavoidable differences between self-report and objective measures of physical activity as self-report questions may not pick up sporadic bouts of incidental exercise during leisure-time, while accelerometers are unable to detect arm movements or water-based physical activity (LeBlanc & Janssen, 2010; S. A. Prince et al., 2008). The small correlations between self-reported physical activity and objectively measured physical activity, both within this thesis, and in previous research, highlight the vast differences between measures (S. A. Prince et al., 2008). Further, self-report measures of leisure-time physical activity are likely to detect the total time spent undertaking an activity which may be physically active. However, evidence shows that less than 50% of the time spent in organised sport is spent participating in moderate-to-vigorous physical activity (Wickel & Eisenmann, 2007). As such, the relationship between self-report and objective measures could depend on how aware young people are of the time they actually spend active during physical activity sessions. Therefore, it may be possible that the total time spent in a physically activity situation or environment, perhaps with friends, learning skills, feeling competent, and doing something enjoyable, is more important to mental health than the amount of time physically expending energy. If this is correct, then a physiological explanation of the effect of physical activity on mental health may be inaccurate. Alternatively, physiological explanations such as an increased release of endorphins or higher serotonin may be correct, but the presence or absence of other factors such as competence and positive social interactions

may either undermine or add to any mental health benefits derived from physiological mechanisms.

Overall, not only does the relationship between physical activity and wellbeing vary between different domains, but the role of motivation also varies. As such, the psychological benefits of physical activity appear contextually specific and, therefore, not all physical activity behaviours will necessarily benefit mental health. This finding calls for motivation, along with other contextual and psychological factors, to be investigated specifically within different physical activity domains, as factors which may predict positive psychological outcomes in one domain may have no impact in another domain. Understanding which factors are most likely to predict positive psychological outcomes within each physical activity domain could lead to better, more specific interventions and guidelines that are more likely to promote mental health.

Strengths and Limitations

A major strength of this study is that it is the first to assess whether motivation moderates the relationships between domain-specific physical activity and affective wellbeing. Consequently, this is the first study to demonstrate that motivation moderates the relationship between active travel and affect. Additionally, this is the first study to identify the association between objectively measured domain-specific physical activity and affective wellbeing. Although using accelerometers is a step in the right direction in terms of obtaining more reliable measures of domain-specific physical activity, a limitation of this study is that the objective measure of active travel still encompassed a self-report component. While physical activity was measured objectively, identifying the specific physical activity bouts that occurred during a student's trip to or from school was reliant on self-reported data (i.e., self-reporting the time of the day students were travelling in order to calculate objectively measured physical activity during this

time). Using global positioning systems or wearable cameras together with accelerometers would enable researchers to objectively identify the life domain of each physical activity bout and, therefore, obtain more accurate assessments of domain-specific physical activity. This type of measurement should be considered in the future.

Unlike in Chapter 3 where positive and negative affect were measured specifically in relation to different physical activity domains, in this study affect was measured more broadly over a 4 week period and not during or after physical activity. Additionally, broad motivational constructs (e.g., autonomous motivation) including multiple regulations (e.g., intrinsic motivation and identified regulation) were used to measure motivation. Given that intrinsic motivation is defined by positive emotions such as enjoyment, but identified regulation is not, autonomous motivation was not solely defined by positive emotions. Similarly, controlled motivation was not solely defined by negative emotions. Therefore, measurement issues are unlikely to be the cause of the relationships between motivation and affect. Additionally, if the measurement of affect and motivation was responsible for the results, the same moderating roles of motivation would be expected across the objective and self-report data and across both physical activity domains; however, this was not the case.

A number of limitations should also be noted. This study only included two physical activity domains, leisure-time physical activity and active travel. It would be beneficial in the future to also measure physical activity during the school day (e.g., breaks, school sport, and physical education), to determine if motivation also moderates the relationships between these domains and wellbeing. Also, all participants in this study were from low socioeconomic areas. While the relationships that were significant in the unadjusted model remained significant in the fully adjusted model, results varied slightly when adding age, sex, socioeconomic status, and body mass index. Therefore,

further studies are needed to understand the potential influence of socioeconomic status on these relationships so that targeted approaches to improving mental health can be made for different populations. Lastly, while some relationships identified in this study approached significance, a model may be significant if the model is wrong due to uncontrolled bias (Rothman, Greenland, & Lash, 2008). As such, further studies analysing motivation as a moderator are needed in order to better understand the roles that both autonomous and controlled motivation play. Finally, longitudinal investigations should also be prioritised to understand any reciprocal relationships between physical activity and mental wellbeing.

Conclusions

Given that poor mental health is the leading contributor to disease burden among adolescents (Begg et al., 2007), mental health guidelines should acknowledge the importance of leisure-time specific physical activity, rather than physical activity more generally during any life domain. However, given the difficulty of increasing participation in leisure-time physical activity (Biddle & Mutrie, 2015), understanding how to improve the effect of physical activity undertaken during other domains is also imperative. Although active travel is not as strongly associated with affective wellbeing as leisure-time physical activity, those who autonomously walk or ride to school experience positive affect while those who feel forced or pressured experience negative affect. As such, finding ways to enhance autonomous motivation towards active travel is an important endeavour also.

Synopsis

This chapter demonstrated that leisure-time physical activity is more strongly associated with affective wellbeing than active travel, but active travel may be

beneficial if it is undertaken for autonomous reasons. The following chapter draws together the findings from this thesis, discusses such findings in relation to the broader literature, and proposes several future directions.

CHAPTER 6: Discussion and Conclusions

Overview of Findings

This thesis has investigated the relationship between physical activity and mental health, mental ill-health, and mental wellbeing, specifically the affective component of mental wellbeing. Given that physical activity includes a broad variety of behaviours, the overarching aim was to understand factors influencing the relationship between physical activity and mental health related variables, so that mental health can be better promoted through physical activity. To achieve this aim, two distinct factors were examined: the life domain in which physical activity is undertaken and motivation towards domain-specific physical activity.

This thesis found that the life domain in which physical activity is conducted influences the relationship between physical activity, and mental health as seen in Study 1 (systematic review), and affective wellbeing as seen in Study 2 (qualitative investigation) and Study 4 (quantitative examination). Study 4 showed that the relationship between physical activity and affective wellbeing is not consistent across domains, while Study 2 showed that adolescents believed leisure-time physical activities led to more positive affect than active travel or physical education. Further, Study 1 demonstrated that leisure-time physical activity was the only physical activity domain to be positively associated with mental health and inversely associated with mental ill-health. Study 1 also showed that life domain significantly moderates the relationship between physical activity and mental ill-health; such that leisure-time physical activity is associated with reduced mental ill-health while work-related physical activity is associated with increased mental ill-health.

This thesis also identified that motivation moderates the relationship between domain-specific physical activity and mental wellbeing. In Study 2, motivation appeared to be an important construct as physical activities that adolescents believed led to positive affect were predominantly undertaken for autonomous reasons, while physical activity associated with negative affect was largely undertaken due to controlled motivation. Study 4 quantitatively tested this hypothesis and showed that motivation was, in fact, a significant moderator of the relationships between active travel and affective wellbeing. More specifically, Study 4 showed that active travel was only positively associated with positive affect when adolescents were autonomously motivated, but associated with negative affect when undertaken for controlled reasons.

Discussion of Main Findings

Physical Activity Guidelines

The World Health Organization (2010) physical activity guidelines state that adolescents should participate in 60 minutes of moderate-to-vigorous physical activity each day and adults should participate in 150 minutes per week (see Figure 6). The World Health Organization (2010) also indicates that physical activity should include “play, games, sports, transportation, recreation, physical education, or planned exercise, in the context of family, school, and community” for youth (World Health Organization, 2010, p .20) and “leisure-time physical activity, transportation (e.g., walking or cycling), occupational (i.e., work), household chores, play, games, sports, or planned exercise in the context of daily, family, and community” for adults (World Health Organization, 2010, p .26). However, promoting physical activity during any life domain is a relatively new concept within physical activity guidelines. Indeed, previous guidelines focused on structured exercise for athletes (Blair, LaMonte, & Nichaman, 2004).

Children and Adolescent Physical Activity Guidelines (5 – 17 Years)

1. Children and youth aged 5–17 should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity daily.
2. Amounts of physical activity greater than 60 minutes provide additional health benefits.
3. Most of the daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least 3 times per week.

Adult Physical Activity Guidelines (18 – 64 Years)

1. Adults aged 18–64 should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week *or* do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week *or* an equivalent combination of moderate- and vigorous-intensity activity.
2. Aerobic activity should be performed in bouts of at least 10 minutes duration.
3. For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, *or* engage in 150 minutes of vigorous-intensity aerobic physical activity per week, *or* an equivalent combination of moderate- and vigorous-intensity activity.
4. Muscle-strengthening activities should be done involving major muscle groups on 2 *or* more days a week.

Figure 3. Global physical activity guidelines for children, adolescents, and adults

(World Health Organization, 2010).

Evolution of the Guidelines

Physical activity guidelines across the globe have evolved since the first guideline in 1975 (Blair et al., 2004); which focused on vigorous-intensity exercise for fitness (Pate et al., 1995). In the early 1990s evidence showed that physical activity was useful for combating the public health burden of chronic diseases, and recognised that that physical activity was not only important for athletes (Blair et al., 2004). As such, the value of moderate-intensity physical activity for the general population was recognised (Blair et al., 2004). In 1995, the American College of Sports Medicine reduced the focus on intensity and suggested greater focus on duration and frequency, recommending 30 minutes of moderate-intensity physical activity each day (Pate et al., 1995). In the early 2000s, as the prevalence of obesity increased in many western countries, the Institute of Medicine and the International Association for the Study of Obesity suggested that 30 minutes of physical activity may be insufficient in preventing weight gain (Saris et al., 2003; Trumbo, Schlicker, Yates, & Poos, 2002). In response, a number of physical activity guidelines (e.g., Australia and the United Kingdom)

recommended 60 minutes of activity on most days for adolescents (Tremblay & Haskell, 2012). Several physical activity guidelines, including the World Health Organization's global guidelines, still recommend 30 minutes a day for adults. However, in 2014, the Australian physical activity guidelines doubled the dose of physical activity for adults from the worldwide consensus of 150 minutes per week to 300 minutes per week.

Between 2000 and 2010, evidence began to support a minimum duration of 10 minutes for physical health benefits (Haskell et al., 2007) and several countries recommended that individuals achieve the necessary amount of physical activity by participating in 10 minute bouts of exercise throughout the day (Warburton, Katzmarzyk, Rhodes, & Shephard, 2007). This newfound knowledge, combined with the difficulty experienced in increasing deliberate physical activity participation during leisure-time (Biddle & Mutrie, 2015), resulted in modern physical activity guidelines stressing the importance of moderate-intensity "lifestyle" physical activity. Guidelines across the globe (e.g., Australia and Canada) now encourage individuals to be active during any life domain (Canadian Society for Exercise Physiology, 2011; Department of Health and Ageing, 2014; World Health Organization, 2010). This approach can be seen in the following excerpt from the current Australian physical activity guidelines (Figure 7).

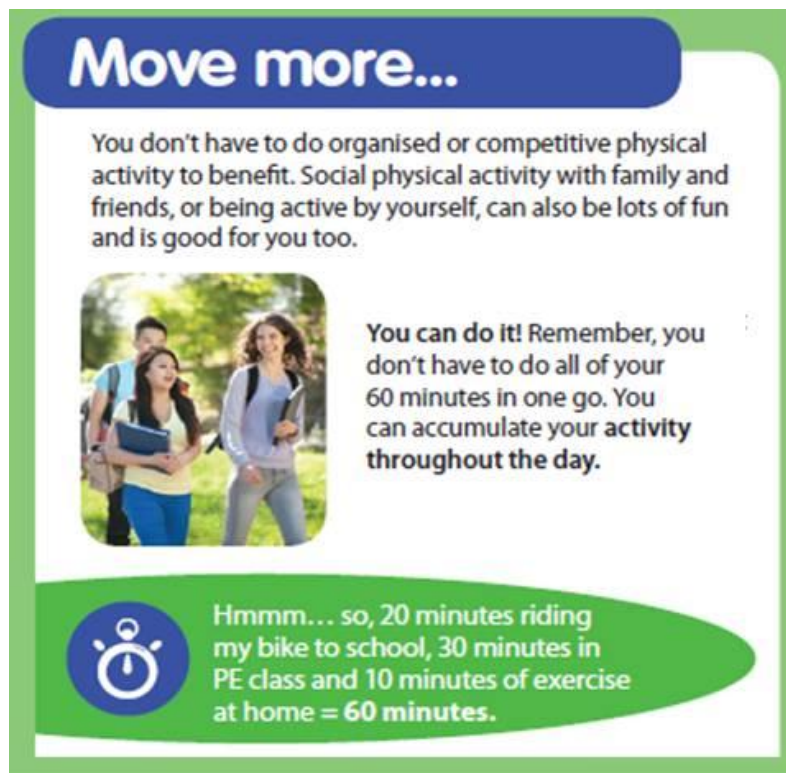


Figure 4. Excerpt from Australia's physical activity guidelines for adolescents (Department of Health and Ageing, 2014).

Public Messages

Any activity counts. The message of being active in any life domain has also been included in physical activity campaigns presented to the general public. Figure 8 shows a series of screenshots from one particular campaign in the UK entitled “It All Adds Up.” The television advertisement not only shows adolescents participating in physical activity in various domains (e.g., leisure-time and active travel), it also includes the phrase “10 minutes here, 15 minutes there, just make sure it all adds up to the 60 minutes they need every day” (Public Health Agency, 2010). Indeed, any activity does add up to 60 minutes of moderate-to-vigorous physical activity, but does it add up to improved mental health? Does it add up to making youth “stay happy and healthy” as the campaign claims it does? Evidence from this thesis suggests the answer may be no; at least not for all individuals.

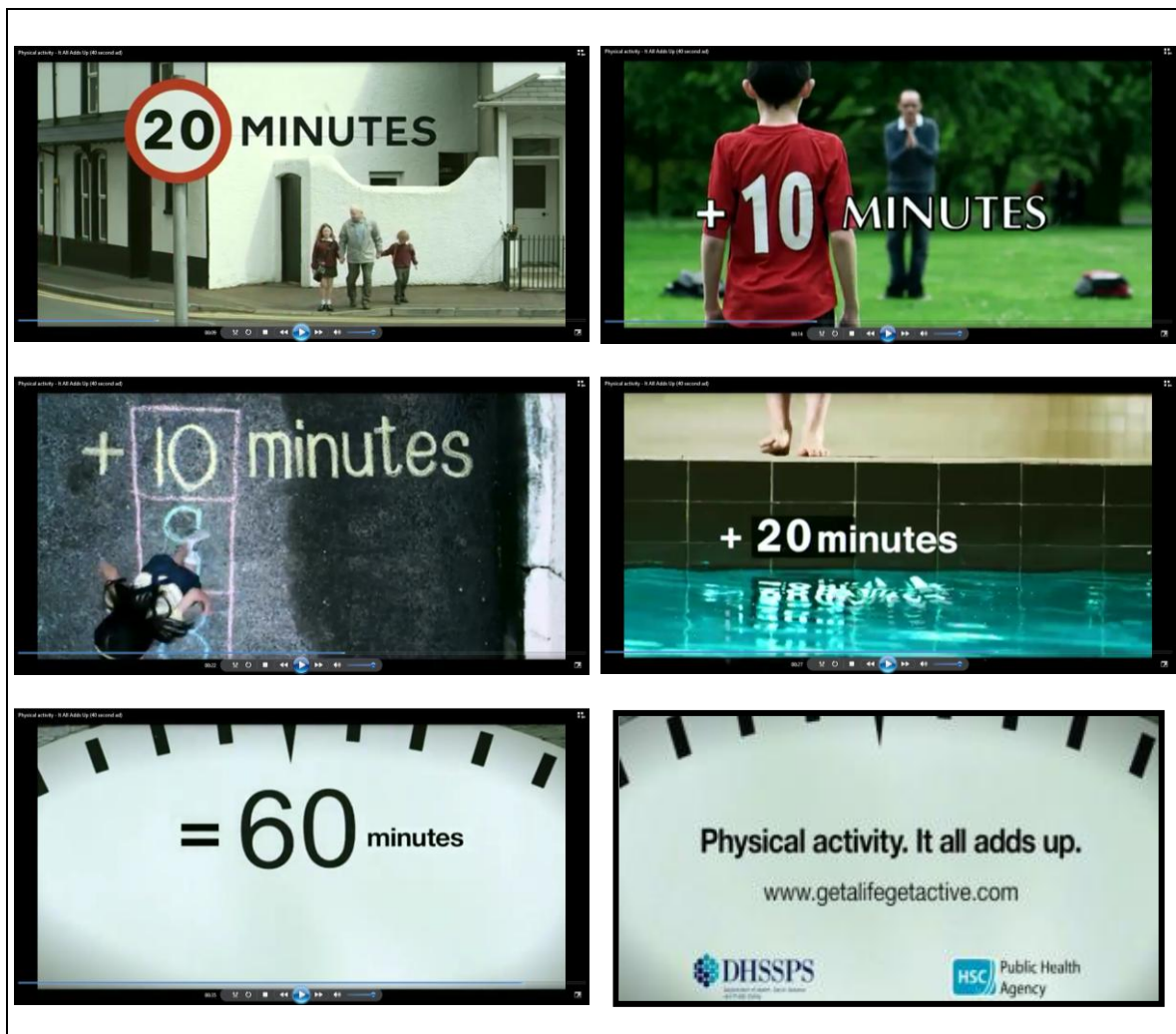


Figure 5. Series of screenshot images from the “It All Adds Up” campaign television advertisement (Public Health Agency, 2010).

Move more, sit less. The current Australian physical activity guidelines encourage individuals to “move more, [and] sit less” (Department of Health and Ageing, 2014, p. 2). Figure 9 demonstrates the current promotion of move more, sit less by using phrases such as “go for a walk...do squats while the kettle boils...get off the bus a stop or two early. You’ll feel better if you move” (The Department of Premier and Cabinet, 2015). But, will any form of moving lead to improved mental wellbeing and the prevention of mental health disorders? Or, are more detailed guidelines and suggestions required? Certainly physical activity guidelines have become more detailed in the last 20 years, and they now provide more specific suggestions. However, there is

a need for further development if physical activity is to benefit mental health as the guidelines suggest it will.



Figure 6. Tasmanian government print media promoting “move more, sit less” (The Department of Premier and Cabinet, 2015).

While modern physical activity guidelines are based on high-quality evidence showing that 60 minutes of moderate-to-vigorous physical activity is necessary for a range of health benefits, the systematic review conducted for the purpose of updating the Australian youth physical activity guidelines included fewer studies relating to mental health benefits ($n = 18$) than physical health benefits such as adiposity ($n = 62$) and cardiorespiratory fitness ($n = 41$) (Okely et al., 2012). Nevertheless, it has been suggested that “compliance with [the physical activity] guidelines can improve... aspects of mental health” (Okely et al., 2012, p. 27). Findings from this thesis, however, indicate that this may not always be the case.

The Importance of Life Domain

This thesis identified that life domain is important to the relationship between physical activity and mental health related outcomes. The role of life domain is so influential that physical activity may have completely opposite effects on mental ill-health depending on the context in which it is undertaken. Indeed, Study 1 showed that leisure-time physical activity is associated with *reduced* mental ill-health while work-related physical activity is associated with *increased* mental ill-health. Further, a number of life domains (e.g., physical education and household physical activity) have no relationship with either mental health or mental ill-health. As such, many individuals who are meeting physical activity guidelines may not be receiving any mental health benefits. Consequently, life domain should be considered in future research, interventions, treatment methods, and perhaps most importantly, physical activity guidelines.

The Role of Motivation

Although physical activity appears to be a chosen behaviour, this may not be the case for *all* physical activity behaviours. Incidental “active living” behaviours particularly, may not be perceived as involving choice (Biddle & Mutrie, 2015). For example, some individuals may be forced to walk or cycle as a means of transportation due to there being no other method of travel available to them. Indeed, one study highlighted the lack of control students have over their own participation in active travel, reporting that only one quarter of Australian children are included in decision making regarding their mode of transport to school (Cycling Promotion Fund, 2012).

Ample research has acknowledged the importance of autonomous motivation in terms of promoting healthy behaviours such as physical activity (i.e., leisure-time physical activity and physical education participation) and reducing unhealthy

behaviours such as screen-time (D. R. Lubans et al., 2013; Owen et al., 2014). However, this thesis extends findings regarding the importance of motivational constructs by showing they influence the relationship between physical activity and affective wellbeing. Although autonomous motivation may not be a predictor of adolescents' active travel participation, it appears to determine whether active travel is associated with positive or negative affective wellbeing. More specifically, active travel was positively associated with positive affect for students who were more autonomously motivated. Promoting autonomous motivation towards active travel could be useful in improving the mental health benefits associated with active travel to school. However, the role of controlled motivation is also important, as active travel was associated with increased negative affect for those who reported higher controlled motivation, but reduced negative affect for those reporting lower controlled motivation. Therefore, promoting participation in physical activity that individuals autonomously endorse appears to be an important endeavour.

“Move More” or “Move More in Ways You Enjoy”?

Encouraging people to move more and sit less is an understandable, and likely effective, strategy to increase people's physical activity behaviour. However, findings from this thesis demonstrate that “move more, sit less” campaigns (see Figure 10) may not lead to improved mental health even if they lead to increased physical activity. Campaign advertisements have a wide reach and can be an effective tool in conveying messages to the general public, yet they do not encourage participation in autonomously endorsed physical activity. Indeed, there are benefits to cardiovascular health from sitting less and moving more, but could this message be improved so that people are encouraged to do activity they autonomously endorse and, therefore, receive mental health benefits alongside the physical benefit of moving more and sitting less.



Figure 7. The Heart Foundation’s image featuring the “move more, sit less” slogan (Heart Foundation, 2015).

Without a doubt updating physical activity guidelines encompasses several challenges and so too does crafting encouraging and supportive public campaigns that accompany the guidelines and the science behind the guidelines (Tremblay & Haskell, 2012). This struggle is demonstrated in Figure 11 which is a modified version of the Heart Foundation’s move more, sit less image to include the words “by doing activities that you autonomously endorse because they are fun, enjoyable, or personally important to you.” While words such as “autonomously endorse” are not likely to be understood by the general public, Figure 11 demonstrates the type of action needed in order to improve the mental health benefits derived from physical activity participation.



Figure 8. First adaptation of the Heart Foundation’s image featuring the “move more, sit less” slogan representing the difficulty of crafting specific but catchy slogans to promote to the public (Heart Foundation, 2015).

Although it is difficult to convey encouraging messages to the public, it can be achieved, and certainly it needs to be a priority if physical activity is to truly play a role in mental health promotion that is equal in magnitude to its potential. One possible example of a supportive and targeted campaign image is shown in Figure 12. Including the words “in ways you enjoy” is not likely to detract from the “move more, sit less” message and is simple; yet it reflects the importance of autonomous motivation and encourages individuals to choose physical activity they find enjoyable. If campaign advertisements and physical activity guidelines begin to encourage people to participate in fun and enjoyable physical activities that are interesting or valuable, the likelihood of receiving mental health benefits alongside physical benefits may increase.



Figure 9. Second and more realistic adaption of the Heart Foundation’s image featuring the “move more, sit less” slogan (Heart Foundation, 2015).

Future Directions

While this thesis adds to the current literature regarding the relationship between physical activity and mental health, it also inspires a number of important future directions that are required before physical activity guidelines and campaigns can be modified. Despite a rapid growth in the number of studies examining domain-specific physical activity in the last five years, two areas remain lacking in evidence. Firstly, there is a lack of evidence regarding all domains other than leisure-time. Without further understanding the impact of work, school, transport, and household-related physical activity on mental health, it is difficult to know what life domains to promote physical

activity within and what domains require further attention. It is also difficult to know how well the current guidelines are promoting mental wellbeing through physical activity, when the impact of each domain is not entirely understood. Secondly, there is far less evidence among youth – compared to adults – across all physical activity domains. This paucity of research with children and adolescents is perhaps one of the most important shortcomings of the domain-specific physical activity literature. Indeed, half of all lifetime mental health disorders arise in or before young adolescence (Kessler et al., 2005). Additionally, adolescent-specific physical activity domains including physical education and school sport account for nearly half of adolescents’ weekly physical activity (Carlson et al., 2016). As such, school-based physical activity urgently needs to be prioritised in terms of understanding the impact on mental health among youth.

One particular future direction regarding physical education that could be advantageous involves better developing fundamental movement skills. The major reason why some students experienced negative affect during physical education was because they felt incompetent compared to others. Unfortunately, Hardy et al. (2011) identified a very low proficiency of fundamental movement skills among 12 year olds. Thus, enhancing students’ competence in fundamental movement skills could improve the relationship between physical activity during physical education and mental health. Evidence within educational settings shows that feeling incompetent towards science tasks is associated with anxiety and frustration, while feeling competent is associated with pride and happiness (Bellocchi & Ritchie, 2015). Similarly, when a student’s need for competence is supported, the potential for physical education to benefit wellbeing will likely increase. As such, either better training primary school teachers (e.g., K. E. Cohen, Morgan, Plotnikoff, Callister, & Lubans, 2015; Lonsdale, Sanders, et al., 2016)

or employing specialised physical education teachers in primary schools could be useful in order to better developed fundamental movement skills (Morgan et al., 2013).

Given the global emphasis on promoting physical activity within a variety of life domains (World Health Organization, 2010), further evidence is required to identify mediators and moderators that influence whether these behaviours are beneficial or detrimental to mental health. Although motivation was found to be a significant moderator in the active travel domain it is unknown whether motivation plays a similar role in other domains such as work-related physical activity. As work-related physical activity accounts for a large portion of some people's weekly physical activity (Jurakić et al., 2009), understanding why increased work-related physical activity is associated with higher psychological distress, and for whom it is most detrimental, is also important. This understanding might enable the development of workplace initiatives that reduce the impact of work-related physical activity on psychological distress.

As this thesis identified that motivation plays an important role in determining whether active travel is associated with positive or negative affect, a vital area of future research relates to identifying effective methods of promoting autonomous motivation towards active travel. Self-determination theory suggests that behaviours which are initially undertaken due to being controlled can become more self-determined by satisfying individuals' needs for competence and relatedness, even if the activity does not satisfy their need for autonomy (Ryan & Deci, 2000a). As such, promoting the satisfaction of relatedness and competence are likely to be important as suggested in Study 2. Fortunately, many adolescents already hold strong interpersonal relationships with their school peers (La Greca & Harrison, 2005) who also need to travel to the same destination. Thus, encouraging adolescents to actively travel to school with their peers might capitalise on existing relationships to satisfy students' need for relatedness and

result in increased mental health benefits. A number of school based strategies could be implemented including walking or riding groups (Active Healthy Kids Australia, 2014). Such groups could enhance social interaction and increase the relationship between active travel and adolescents' mental wellbeing by satisfying their need for relatedness. Strategies such as developing common walking routes near schools and providing additional bus stops farther away from school to encourage students to walk the remainder of the trip with their peers could also be useful.

Organismic integration theory also posits that individuals will be more likely to internalise motivation towards active travel if they feel competent (Ryan & Deci, 2000a). While this approach may be effective in terms of enhancing autonomous motivation towards other physical activity behaviours, it may be limited in terms of active travel given the simplicity of walking – perceived competence towards walking is likely high for most people (Sohn, Hasnain, & Sinacore, 2007). However, this thesis found that some students were happy when walking to school because they were being trusted to travel independently. This supports earlier findings that adolescents want to travel independently (Lorenc, Brunton, Oliver, Oliver, & Oakley, 2008). Therefore, active travel and independence may be an important avenue to explore further, as perhaps encouraging the notion of independence could be advantageous in terms of promoting mental wellbeing through active travel to school.

Study 2 (qualitative) and Study 4 (quantitative) within this thesis specifically focused on active travel to and from school. It would also be useful to measure active travel within leisure-time, compared to active travel to school and compared with other leisure-time physical activities such as organised sport. Walking or cycling to a friend's house or to a shopping centre may function much the same as walking to school and have no relationship with affective wellbeing unless autonomous motivation is high.

Alternatively, leisure-time transport may act more like other leisure-time physical activity behaviours because the activity is not being controlled by some required endpoint (i.e., school). This knowledge could help to further understand the role of both life domain and motivation, and lead to more specific physical activity recommendations. Additionally, given that one of the major controlling components of adolescents' active travel comes from parental control, it is possible that the relationship between active travel and affective wellbeing – as well as the impact of motivation – are rather different for adults compared to adolescents. And thus, the relationship among adults needs to be explored.

This thesis supports self-determination theory tenets by finding that autonomously motivated physical activity is associated with more positive mental wellbeing. Future investigations could test whether this relationship is due to the satisfaction of psychological needs. Understanding which psychological needs are most important for mental health benefits would also be beneficial. Teixeira et al. (2012) showed that competence was associated with physical activity participation more strongly than autonomy or relatedness. Thus, it is possible that adolescents choose to continue to participate in leisure-time physical activity in which they feel competent, more than physical activity in which they do not. As such, any mental health benefits derived from leisure-time physical activity may be largely due to the satisfaction of their need for competence. While there is not likely to be any disadvantage to mental health if physical activity behaviours more fully satisfy all three psychological needs, if one psychological need plays a larger role then this would suggest the single approach that is most likely to improve the relationship between physical activity and mental health. However, the psychological need which is most important may vary across domains. For example, walking to school may not be associated with feelings of competence given that walking is one of the simplest exercises to perform (Sohn et al., 2007). And

perhaps, mental health benefits of active travel may be more likely to be derived from the satisfaction of relatedness, rather than the satisfaction of competence. Understanding the role each psychological need plays in each physical activity domain could guide the development of targeted strategies and guidelines which provide more potential for improving mental health through physical activity.

Arguably, the simplest implication from this thesis is that, at a population level, physical activity specifically within leisure-time has a stronger relationship with positive mental health than physical activity within any other domain. However, the task of increasing participation in deliberate physical activity behaviours, such as leisure-time sports, has proven difficult (Biddle & Mutrie, 2015). Therefore, it is no surprise that efforts have shifted towards promoting incidental physical activity during a variety of lifestyle related behaviours throughout the day (Sallis et al., 2006). It is likely that this approach will increase people's total physical activity participation (Active Healthy Kids Australia, 2014; Jurakić et al., 2010; M. P. Smith et al., 2016). However, it is unclear whether this will impact mental health positively, particularly if individuals are physically active solely at school or work, or as a method of travel, and they do so for controlled reasons, such as feeling forced or pressured. As such, promoting leisure-time physical activity, such as organised sport, needs to remain an important objective, given that the mental health benefits of leisure-time physical activity are not guaranteed across other life domains. However, in terms of physical activity outside leisure-time, determining ways of promoting autonomous motivation and reducing controlled motivation are warranted. Such methods would likely improve the relationship between mental health and physical activity behaviours that may not be inherently satisfying for many people.

Strengths and Limitations of this Thesis

This thesis delivers the first meta-analytic evidence of the relationship between domain-specific physical activity and mental health. Therefore, this thesis provides the most comprehensive evidence that leisure-time physical activity is more strongly associated with mental health and wellbeing than physical activity accumulated in other life domains. This finding is a valuable contribution to the field as it adds to the existing literature on mental health and physical activity by understanding the importance of life domain. Additionally, the number of studies synthesised and the variety of mental health related outcomes included, drew a comprehensive and detailed picture of the relationship between domain-specific physical activity and mental health. Further, 66% percent of the studies synthesised in Study 1 (meta-analysis) were published in the last five years and 88% were published in the last 10 years. Therefore, the timely nature of Study 1 is also an important strength.

The main strength of this thesis, however, was the novelty of findings relating to motivation. This thesis includes the first evidence to show that motivation moderates the relationship between active travel and affective wellbeing, such that more autonomously motivated active travel has a stronger relationship with affective wellbeing than active travel undertaken due to controlled motivation. This finding is novel and important to the promotion of positive affect through physical activity. Additionally, this thesis involved the development of an instrument to measure adolescents' motivation towards active travel, which has previously not been measured. As such, motivation towards active travel can now be examined as a predictor of physical activity, as an outcome of interventions designed to enhance motivation, and as a moderator of the effect on mental wellbeing. Furthermore, since domain-specific physical activity has been predominantly measured via self-report methods, the objective measurement of leisure-time physical activity and active travel was also a strength of this research, as was the

large sample size in Study 4. The mixed methods approach employed was also advantageous as it allowed for a broad initial understanding of the role of motivation (Creswell & Clark, 2007).

Despite a number of strengths, some limitations exist. Data for this thesis were predominantly collected from adolescents aged 11-15 years attending school in Western Sydney, Australia. This limits the generalisability of study results to other students, including older adolescents, children, and students living in other geographical locations, nationally or internationally. Additionally, all participants in Study 4 were from low socioeconomic areas. Given that the characteristics of a sample influence the generalisability of study results, the generalisability of results regarding motivation being a moderator variable are limited to low socioeconomic areas (Gartlehner, Hansen, Nissman, Lohr, & Carey, 2006). While it is possible a similar relationship may be present in higher socioeconomic areas, this hypothesis needs to be examined in large representative samples.

Additionally, the cross sectional nature of Study 4 means causal links between physical activity and mental wellbeing could not be determined. Additionally, reverse causality could not be explored. Another limitation of this thesis is that physical education was only included in the qualitative study. While this study provided preliminary evidence showing that motivation is perceived to influence the impact of physical education on immediate affect, not measuring the dose of physical education provided to students in Study 4 means that the relationship between physical education and longer term affective wellbeing, and the role of motivation in this relationship, are still unknown.

Due to the self-report nature of the wellbeing and motivation measurements, data is partially dependent on how well the students followed instructions and

responded honestly. Further, although objective measures of physical activity were included in this thesis, the objective measure of active travel involved a self-report component, and a limitation of this thesis is therefore, the lack of a purely objective measure of active travel. Using global positioning system devices or wearable cameras to identify active travel objectively would have improved the strength of this research. Using global positioning systems and wearable cameras would also be advantageous by enabling all physical activity bouts within a persons' weekly physical activity to be categorised as a specific life domain. This methodological approach would lead to understanding of all adolescent-specific physical activity domains, rather than selecting a limited number of domains to measure. Additionally, it would also reduce uncertainty due to any overlap of domains. For example, this thesis did not measure household physical activity or active travel within leisure time as separate to leisure-time. However, using global positioning systems or wearable cameras in the future would make this possible.

Concluding Remarks

Not all physical activity behaviours guarantee the maintenance of mental wellbeing and the prevention of mental ill-health. Nevertheless, physical activity can be associated with affective wellbeing when contextual and psychological variables are considered. Based on the results of Study 1 (meta-analysis), promoting leisure-time physical activity is likely to be the single most effective method of improving mental health through physical activity at a population level. However, Study 2 (qualitative) and Study 4 (quantitative) explored some of the variation within physical activity domains and showed that developing autonomous motivation towards physical activity is important to mental wellbeing, as in some cases (i.e., active travel) it determines whether physical activity is associated with positive or negative affect. In conclusion,

efforts should be made to encourage autonomous participation in physical activity that is enjoyable, interesting, personally important, and full of opportunities for experiencing competence and relatedness, so that mental health can be more effectively improved through physical activity.

References

*References marked with an asterisk indicate studies included in the meta-analysis.

Active Healthy Kids Australia. (2014). *Is Sport Enough? The 2014 Active Healthy Kids Australia Report Card on Physical Activity for Children and Young People*.

Adelaide, South Australia: Active Healthy Kids Australia. Retrieved from

https://heartfoundation.org.au/images/uploads/publications/ahka_reportcard_longform.pdf.

Aiken, L. R. (1985). Three coefficients for analyzing the reliability and validity of ratings. *Educational and Psychological Measurement*, 45(1), 131-142.

*Aldana, S. G., Sutton, L. D., Jacobson, B. H., & Quirk, M. G. (1996). Relationships between leisure time physical activity and perceived stress. *Perceptual and Motor Skills*, 82(1), 315-321.

Alexander, L. M., Inchley, J., Todd, J., Currie, D., Cooper, A. R., & Currie, C. (2005). The broader impact of walking to school among adolescents: seven day accelerometry based study. *British Medical Journal*, 331(7524), 1061-1062.

Anderson, C. (2010). Presenting and evaluating qualitative research. *American Journal of Pharmaceutical Education*, 74(8), 141.

*Armstrong, K., & Edwards, H. (2004). The effectiveness of a pram-walking exercise programme in reducing depressive symptomatology for postnatal women. *International Journal of Nursing Practice*, 10(4), 177-194. doi: 10.1111/j.1440-172X.2004.00478.x

Astell-Burt, T., Feng, X., & Kolt, G. S. (2013). Mental health benefits of neighbourhood green space are stronger among physically active adults in middle-to-older age: Evidence from 260,061 Australians. *Preventive Medicine*, 57(5), 601-606.

*Asztalos, M., Wijndaele, K., De Bourdeaudhuij, I., Philippaerts, R., Matton, L., Duvigneaud, N., . . . Cardon, G. (2009). Specific associations between types of

- physical activity and components of mental health. *Journal of Science and Medicine in Sport*, 12(4), 468-474. doi: 10.1016/j.jsams.2008.06.009
- Australian Bureau of Statistics. (2006). *Community participation of people with a disability*. Canberra: Australian Bureau of Statistics Retrieved from <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Previousproducts/66A7963E00C12206CA2571B00010334A?opendocument>.
- Australian Institute of Health and Welfare. (2003). *Australia's young people: Their health and wellbeing 2003*. Australian Institute of Health and Welfare. Retrieved from www.aihw.gov.au/publication-detail/?id=6442467534.
- Babic, M. J., Morgan, P. J., Plotnikoff, R. C., Lonsdale, C., White, R. L., & Lubans, D. R. (2014). Physical activity and physical self-concept in youth: Systematic review and meta-analysis. *Sports Medicine*, 44(11), 1589-1601.
- Bailey, M., & McLaren, S. (2005). Physical activity alone and with others as predictors of sense of belonging and mental health in retirees. *Aging and Mental Health*, 9(1), 82-90.
- *Balboa-Castillo, T., León-Muñoz, L. M., Graciani, A., Rodriguez-Artalejo, F., & Guallar-Castillon, P. (2011). Longitudinal association of physical activity and sedentary behavior during leisure time with health-related quality of life in community-dwelling older adults. *Health and Quality of Life Outcomes*, 9(1), 47-56. doi: 10.1186/1477-7525-9-47
- Baraldi, A. N., & Enders, C. K. (2010). An introduction to modern missing data analyses. *Journal of School Psychology*, 48(1), 5-37.
- *Barrington, W. E., Ceballos, R. M., Bishop, S. K., McGregor, B. A., & Beresford, S. A. A. (2012). Perceived stress, behavior, and body mass index among adults participating in a worksite obesity prevention program, seattle, 2005-2007. *Preventing Chronic Disease*, 9(10). doi: 10.5888/pcd9.120001

- Barry, M. M., & Jenkins, R. (2007). *Implementing mental health promotion*. Philadelphia: Churchill Livingstone Elsevier.
- Barton, J., & Pretty, J. (2010). What is the best dose of nature and green exercise for improving mental health? *Environmental Science and Technology*, 44(10), 3947-3955.
- Baumeister, R. F., & Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, 117(3), 497-529.
- Begg, S., Vos, T., Barker, B., Stevenson, C., Stanley, L., & Lopez, A. D. (2007). *The burden of disease and injury in Australia 2003*. Canberra: Australian Institute of Health and Welfare. Retrieved from www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=6442459747.
- Bellocchi, A., & Ritchie, S. M. (2015). "I was proud of myself that I didn't give up and I did it": Experiences of pride and triumph in learning science. *Science Education*, 99(4), 638-668.
- *Bernaards, C. M., Jans, M. P., Van Den Heuvel, S. G., Hendriksen, I. J., Houtman, I. L., & Bongers, P. M. (2006). Can strenuous leisure time physical activity prevent psychological complaints in a working population? *Occupational and Environmental Medicine*, 63(1), 10-16. doi: 10.1136/oem.2004.017541
- *Bertheussen, G. F., Romundstad, P. R., Landmark, T., Kaasa, S., Dale, O., & Helbostad, J. L. (2011). Associations between physical activity and physical and mental health-A HUNT 3 study. *Medicine and Science in Sports and Exercise*, 43(7), 1220-1228. doi: 10.1249/MSS.0b013e318206c66e
- Biddle, S. J. H. (2000). Exercise, emotion, and mental health. In Y. L. Hanin (Ed.), *Emotions in sport* (pp. 267-291). Champaign: Human Kinetics.

- Biddle, S. J. H., & Asare, M. (2011). Physical activity and mental health in children and adolescents: A review of reviews. *British Journal of Sports Medicine*, *45*(11), 886-895.
- Biddle, S. J. H., & Mutrie, N. (2015). *Psychology of physical activity: Determinants, well-being and interventions*. New York: Routledge.
- *Binsinger, C., Laure, P., & Ambard, M. F. (2006). Regular extra curricular sports practice does not prevent moderate or severe variations in self-esteem or trait anxiety in early adolescents. *Journal of Sports Science and Medicine*, *5*(1), 123-129.
- *Birkeland, M. S., Torsheim, T., & Wold, B. (2009). A longitudinal study of the relationship between leisure-time physical activity and depressed mood among adolescents. *Psychology of Sport and Exercise*, *10*(1), 25-34. doi: 10.1016/j.psychsport.2008.01.005
- Bize, R., Johnson, J. A., & Plotnikoff, R. C. (2007). Physical activity level and health-related quality of life in the general adult population: A systematic review. *Preventive Medicine*, *45*(6), 401-415.
- Blair, S. N., LaMonte, M. J., & Nichaman, M. Z. (2004). The evolution of physical activity recommendations: How much is enough? *The American Journal of Clinical Nutrition*, *79*(5), 913S-920S.
- Bogaert, I., De Martelaer, K., Deforche, B., Clarys, P., & Zinzen, E. (2014). Associations between different types of physical activity and teachers' perceived mental, physical, and work-related health. *BioMed Central Public Health*, *14*(1). doi: 10.1186/1471-2458-14-534
- Bohnert, A. M., Richards, M. H., Kolmodin, K. E., & Lakin, B. L. (2008). Young urban African American adolescents' experience of discretionary time activities. *Journal of Research on Adolescence*, *18*(3), 517-539.

- Booth, M. L., Okely, A. D., Chey, T., & Bauman, A. (2001). The reliability and validity of the physical activity questions in the WHO health behaviour in schoolchildren (HBSC) survey: A population study. *British Journal of Sports Medicine*, 35(4), 263-267.
- Borenstein, M., Hedges, L. V., Higgins, J., & Rothstein, H. R. (2010). A basic introduction to fixed-effect and random-effects models for meta-analysis. *Research Synthesis Methods*, 1(2), 97-111.
- Borenstein, M., Hedges, L. V., Higgins, J. P. T. H., & Rothstein, H. R. (2009). *Introduction to meta-analysis*. West Sussex: John Wiley & Sons.
- *Borges, L. J., Benedetti, T. R. B., Xavier, A. J., & deOrsi, E. (2013). Associated factors of depressive symptoms in the elderly: EpiFloripa study. *Revista de Saúde Pública*, 47(4), 701-710. doi: 10.1590/S0034-8910.2013047003844
- Bowen, N. K., & Guo, S. (2011). *Structural equation modeling*: Oxford University Press.
- Boyce, W., Torsheim, T., Currie, C., & Zambon, A. (2006). The family affluence scale as a measure of national wealth: validation of an adolescent self-report measure. *Social Indicators Research*, 78(3), 473-487.
- *Branco, J. C., Jansen, K., Oses, J. P., De Mattos Souza, L. D., Da Silva Alves, G. D. G., Lara, D. R., & Da Silva, R. A. (2014). Practice of leisure-time physical activities and episodes of mood alteration amongst men and women. *Journal of Affective Disorders*, 169, 165-169. doi: 10.1016/j.jad.2014.08.020
- *Brooks, F. M., Smeeton, N. C., Chester, K., Spencer, N., & Klemara, E. (2014). Associations between physical activity in adolescence and health behaviours, well-being, family and social relations. *International Journal of Health Promotion and Education*, 52(5), 271-282. doi: 10.1080/14635240.2014.923287

- *Brunes, A., Augestad, L. B., & Gudmundsdottir, S. L. (2013). Personality, physical activity, and symptoms of anxiety and depression: The HUNT study. *Social Psychiatry and Psychiatric Epidemiology*, 48(5), 745-756. doi: 10.1007/s00127-012-0594-6
- *Brunes, A., Gudmundsdottir, S. L., & Augestad, L. B. (2014). Gender-specific associations between leisure-time physical activity and symptoms of anxiety: The HUNT study. *Social Psychiatry and Psychiatric Epidemiology*, 50(3), 419-427. doi: 10.1007/s00127-014-0915-z
- Brunet, J., Sabiston, C. M., Chaiton, M., Barnett, T. A., O'Loughlin, E., Low, N. C. P., & O'Loughlin, J. L. (2013). The association between past and current physical activity and depressive symptoms in young adults: A 10-year prospective study. *Anal of Epidemiology*, 23, 25-30.
- *Bültmann, U., Kant, I., Kasl, S. V., Schröer, K. A. P., Swaen, G. M. H., & Van den Brandt, P. A. (2002). Lifestyle factors as risk factors for fatigue and psychological distress in the working population: Prospective results from the Maastricht cohort study. *Journal of Occupational and Environmental Medicine*, 44(2), 116-124.
- *Bustamante, E. E., Wilbur, J., Marquez, D. X., Fogg, L., Staffileno, B. A., & Manning, A. (2013). Physical activity characteristics and depressive symptoms in older Latino adults. *Mental Health and Physical Activity*, 6(2), 69-77. doi: 10.1016/j.mhpa.2013.05.001
- *Buttery, A. K., Mensink, G. B., & Busch, M. A. (2014). Healthy behaviours and mental health: findings from the German Health Update (GEDA). *European Journal of Public Health*. doi: 10.1093/eurpub/cku094
- Byrne, B. M. (1994). *Structural equation modeling with EQS and EQS/Windows: Basic concepts, applications, and programming*. Thousand Oaks, California: Sage.

- Canadian Society for Exercise Physiology. (2011). *Physical activity tips for adults (18-64 years)*. Ontario: Public Health Agency of Canada. Retrieved from http://www.csep.ca/CMFiles/Guidelines/CSEP_PAGuidelines_adults_en.pdf.
- Carlson, J. A., Schipperijn, J., Kerr, J., Saelens, B. E., Natarajan, L., Frank, L. D., . . . Cain, K. L. (2016). Locations of physical activity as assessed by GPS in young adolescents. *Pediatrics*, *137*(1), 2015-2430.
- Carver, A., Timperio, A., Hesketh, K., & Crawford, D. (2010). Are children and adolescents less active if parents restrict their physical activity and active transport due to perceived risk? *Social Science and Medicine*, *70*(11), 1799-1805.
- Carver, A., Timperio, A. F., Hesketh, K. D., Ridgers, N. D., Salmon, J. L., & Crawford, D. A. (2011). How is active transport associated with children's and adolescents' physical activity over time? *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 126-131.
- Cattan, M. (2009). *Mental Health And Well Being In Later Life*: McGraw-Hill International.
- Cerin, E. (2010). Ways of unravelling how and why physical activity influences mental health through statistical mediation analyses. *Mental Health and Physical Activity*, *3*(2), 51-60.
- *Cerin, E., Leslie, E., Sugiyama, T., & Owen, N. (2009). Associations of multiple physical activity domains with mental well-being. *Mental Health and Physical Activity*, *2*(2), 55-64.
- Charles, E. P. (2005). The correction for attenuation due to measurement error: clarifying concepts and creating confidence sets. *Psychological Methods*, *10*(2), 206-226.

- *Chen, L. J., Stevinson, C., Ku, P. W., Chang, Y. K., & Chu, D. C. (2012). Relationships of leisure-time and non-leisure-time physical activity with depressive symptoms: A population-based study of Taiwanese older adults. *International Journal of Behavioral Nutrition and Physical Activity*, 9(28). doi: 10.1186/1479-5868-9-28
- Cheon, S. H., Reeve, J., & Moon, I. S. (2012). Experimentally based, longitudinally designed, teacher-focused intervention to help physical education teachers be more autonomy supportive toward their students. *Journal of Sport and Exercise Psychology*, 34(3), 365-396.
- Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling*, 9(2), 233-255.
- Cheung, M. W. L. (2015a). *Meta-analysis: A structural equation modeling approach*. West Sussex, United Kingdom: John Wiley & Sons.
- Cheung, M. W. L. (2015b). metaSEM: An R package for meta-analysis using structural equation modeling. *Frontiers in Psychology*, 5(1521). doi: 10.3389/fpsyg.2014.01521
- *Chi, S. H., Wang, J. Y., & Tsai, A. C. (2015). Combined association of leisure-time physical activity and fruit and vegetable consumption with depressive symptoms in older Taiwanese: Results of a national cohort study. *Geriatrics & gerontology international*, 16(2), 244-251. doi: 10.1111/ggi.12459
- *Choi, J., Wilbur, J., Miller, A., Szalacha, L., & McAuley, E. (2008). Correlates of leisure-time physical activity in Korean immigrant women. *Western Journal of Nursing Research*, 30(5), 620-638. doi: 10.1177/0193945907310645
- Clark, L. A., & Watson, D. (1991). Tripartite model of anxiety and depression: Psychometric evidence and taxonomic implications. *Journal of Abnormal Psychology*, 100(3), 316-336.

- Cohen, J. (1968). Weighted kappa: Nominal scale agreement provision for scaled disagreement or partial credit. *Psychological Bulletin*, 70(4), 213-220.
- Cohen, J. (1977). *Statistical power analysis for the behavioral sciences*. New York: Academic Press.
- Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. New York: Academic press.
- Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2013). *Applied multiple regression/correlation analysis for the behavioral sciences*. New Jersey: Routledge.
- Cohen, K. E., Morgan, P. J., Plotnikoff, R. C., Callister, R., & Lubans, D. R. (2015). Physical activity and skills intervention: SCORES cluster randomized controlled trial. *Medicine and Science in Sports and Exercise*, 47(4), 765-774.
- Commonwealth Department of Health and Aged Care and Australian Institute of Health and Welfare. (1999). *National Health Priority Areas Report: Mental Health 1998*. Canberra: Australian Institute of Health and Welfare. Retrieved from <http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=6442459185>.
- Cooney, G. M., Dwan, K., Greig, C. A., Lawlor, D. A., Rimer, J., Waugh, F. R., . . . Mead, G. E. (2013). Exercise for depression. *The Cochrane Library*.
- Cooper, A. R., Andersen, L. B., Wedderkopp, N., Page, A. S., & Froberg, K. (2005). Physical activity levels of children who walk, cycle, or are driven to school. *American Journal of Preventive Medicine*, 29(3), 179-184.
- Cooper, H. M. (1998). *Synthesizing research: A guide for literature reviews* (Vol. 2): Sage.
- Costello, E. J., Egger, H. L., Copeland, W., Erkanli, A., & Angold, A. (2011). The developmental epidemiology of anxiety disorders: phenomenology, prevalence, and comorbidity. In W. K. Silverman & A. P. Field (Eds.), *Anxiety disorders in*

- children and adolescents* (2nd ed.). Cambridge, UK: Cambridge University Press.
- Costello, E. J., Erkanli, A., & Angold, A. (2006). Is there an epidemic of child or adolescent depression? *Journal of Child Psychology and Psychiatry*, *47*(12), 1263-1271.
- Craft, L. L., & Perna, F. M. (2004). The benefits of exercise for the clinically depressed. *Primary Care Companion to the Journal of Clinical Psychiatry*, *6*(3), 104.
- *Craike, M. J., Coleman, D., & MacMahon, C. (2010). Direct and buffering effects of physical activity on stress-related depression in mothers of infants. *Journal of Sport & Exercise Psychology*, *32*(1), 23-38.
- Cresswell, S. L., & Eklund, R. C. (2006). The convergent and discriminant validity of burnout measures in sport: A multi-trait/multi-method analysis. *Journal of Sports Sciences*, *24*(2), 209-220.
- Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research* (1st ed.). Thousand Oaks, California: Wiley Online Library.
- Crews, D. J., Lochbaum, M. R., & Landers, D. M. (2004). Aerobic physical activity effects on psychological well-being in low-income Hispanic children. *Perceptual and Motor Skills*, *98*(1), 319-324.
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297-334.
- Cycling Promotion Fund. (2012). *Active Travel to School: 2012 Survey Findings*. Victoria: Cycling Promotion Fund. Retrieved from <https://heartfoundation.org.au/images/uploads/publications/Cycling-Survey-2012-Active-Travel-to-School.pdf>.
- Deci, E. L. (1975). *Intrinsic motivation*. New York: Plenum Press.

- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.
- Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227-268.
- Deci, E. L., & Ryan, R. M. (2002a). *Handbook of self-determination research*. Rochester, New York: University of Rochester Press.
- Deci, E. L., & Ryan, R. M. (2002b). An overview of self determination theory: An organismic-dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3-33). Rochester: The University of Rochester Press.
- Deci, E. L., & Ryan, R. M. (2008a). Facilitating optimal motivation and psychological well-being across life's domains. *Canadian Psychology. Psychologie Canadienne*, 49(1), 14-34.
- Deci, E. L., & Ryan, R. M. (2008b). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology. Psychologie Canadienne*, 49(3), 182-185.
- Denzin, N. K., & Lincoln, Y. S. (2008). Introduction: The discipline and practice of qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Strategies of qualitative inquiry* (3 ed., pp. 1-43). Thousand Oaks, California: Sage Publications.
- Department of Health and Ageing. (2014). *National Physical Activity Guidelines for Australians*. Canberra: Commonwealth of Australia. Retrieved from <http://www.health.gov.au/internet/main/publishing.nsf/content/health-publth-strateg-phys-act-guidelines>.

- Department of Health and Human Services. (1999). *Mental health: A report of the surgeon general*. Rockville, Maryland: US Department of Health and Human Services. Retrieved from <https://profiles.nlm.nih.gov/ps/access/NNBBHS.pdf>.
- *Desha, L. N., Ziviani, J. M., Nicholson, J. M., Martin, G., & Darnell, R. E. (2007). Physical activity and depressive symptoms in American adolescents. *Journal of Sport and Exercise Psychology, 29*(4), 534-543.
- DeVellis, R. F. (2012). *Scale development: Theory and applications* (3rd ed.). Los Angeles: Sage Publications.
- Diener, E. (2000). Subjective well-being: The science of happiness and a proposal for a national index. *American Psychologist, 55*(1), 34-43.
- *Doerksen, S. E., Elavsky, S., Rebar, A. L., & Conroy, D. E. (2014). Weekly fluctuations in college student leisure activities and well-being. *Leisure Sciences, 36*(1), 14-34. doi: 10.1080/01490400.2014.860778
- Doherty, D., Kaufman, M., Lindsay, D., Panzer, L., Sharpe, D., & Tonkin, R. (1994). *Age limits and adolescents [policy statement]*. Ottawa: Canadian Paediatric Society. Retrieved from <http://www.cps.ca/documents/position/age-limits-adolescents>.
- Doyne, E. J., Ossip-Klein, D. J., Bowman, E. D., Osborn, K. M., McDougall-Wilson, I. B., & Neimeyer, R. A. (1987). Running versus weight lifting in the treatment of depression. *Journal of Consulting and Clinical Psychology, 55*(5), 748-754.
- Duncan, M. J., Badland, H. M., & Mummery, W. K. (2009). Applying GPS to enhance understanding of transport-related physical activity. *Journal of Science and Medicine in Sport, 12*, 549-556.
- Dunn, J. G. H., Bouffard, M., & Rogers, W. T. (1999). Assessing item content-relevance in sport psychology scale-construction research: Issues and

recommendations. *Measurement in Physical Education and Exercise Science*, 3(1), 15-36.

*Dupuis, S. L., & Smale, B. J. A. (1995). An examination of relationship between psychological well-being and depression and leisure activity participation among older adults. *Society & Leisure*, 18(1), 67-92.

Ebesutani, C., Regan, J., Smith, A., Reise, S., Higa-McMillan, C., & Chorpita, B. F. (2012). The 10-item positive and negative affect schedule for children, child and parent shortened versions: application of Item Response Theory for more efficient assessment. *Journal of Psychopathology and Behavioral Assessment*, 34(2), 191-203.

*Eime, R., Harvey, J., & Payne, W. (2014). Dose-response of women's health-related quality of life (HRQOL) and life satisfaction to physical activity. *Journal of Physical Activity and Health*, 11(2), 330-338. doi: 10.1123/jpah.2012-0073

Ekeland, E., Heian, F., Hagen, K. B., Abbott, J. M., & Nordheim, L. (2009). Exercise to improve self-esteem in children and young people (Review). *The Cochrane Library*(1).

Ermes, M., Parkka, J., Mantyjarvi, J., & Korhonen, I. (2008). Detection of daily activities and sports with wearable sensors in controlled and uncontrolled conditions. *Information Technology in Biomedicine*, 12(1), 20-26.

Evenson, K. R., Catellier, D. J., Gill, K., Ondrak, K. S., & McMurray, R. G. (2008). Calibration of two objective measures of physical activity for children. *Journal of Sports Sciences*, 26(14), 1557-1565.

Faulkner, G., & Biddle, S. J. H. (2004). Exercise and depression: Considering variability and contextuality. *Journal of Sport and Exercise Psychology*, 26, 3-18.

- *Feuerhahn, N., Sonnentag, S., & Woll, A. (2014). Exercise after work, psychological mediators, and affect: A day-level study. *European Journal of Work and Organizational Psychology, 23*(1), 62-79. doi: 10.1080/1359432X.2012.709965
- *Fisher, K. J., & Li, F. (2004). A community-based walking trial to improve neighborhood quality of life in older adults: A multilevel analysis. *Annals Behavioral Medicine, 28*(3), 186-194. doi: 10.1207/s15324796abm2803_7
- Fisher, R. A. (1925). *Statistical methods for research workers*: Genesis Publishing Pvt Ltd.
- *Fløtnes, I. S., Nilsen, T. I. L., & Augestad, L. B. (2011). Norwegian adolescents, physical activity and mental health: The Young-HUNT study. *Norsk Epidemiologi, 20*(2), 153-161.
- Fontaine, K. L. (2009). *Mental health nursing* (6 ed.). Upper Saddle River: Pearson Prentice Hall.
- Fox, K. R. (1999). The influence of physical activity on mental well-being. *Public Health Nutrition, 2*(3a), 411-418.
- Fredrickson, B. L., & Losada, M. F. (2005). Positive affect and the complex dynamics of human flourishing. *American Psychologist, 60*(7), 678-686.
- Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior, 26*(4), 331-362.
- Ganassali, S. (2008). *The influence of the design of web survey questionnaires on the quality of responses*. Paper presented at the Survey Research Methods.
- Gartlehner, G., Hansen, R. A., Nissman, D., Lohr, K. N., & Carey, T. S. (2006). Criteria for distinguishing effectiveness from efficacy trials in systematic reviews: Technical Review 12 (Prepared by the RTI-International–University of North Carolina Evidence-based Practice Center under Contract No. 290-02-0016). Rockville, MD: Agency for Healthcare Research and Quality.

- *Giacobbi Jr, P. R., Tuccitto, D. E., & Frye, N. (2007). Exercise, affect, and university students' appraisals of academic events prior to the final examination period. *Psychology of Sport and Exercise*, 8(2), 261-274. doi: 10.1016/j.psychsport.2006.04.001
- Gillet, N., Vallerand, R. J., Lafrenière, M. K., & Bureau, J. S. (2012). The mediating role of positive and negative affect in the situational motivation-performance relationship. *Motivation and Emotion*, 37, 465–479.
- Goetz, C., Coste, J., Lemetayer, F., Rat, A., Montel, S., Recchia, S., . . . Guillemin, F. (2013). Item reduction based on rigorous methodological guidelines is necessary to maintain validity when shortening composite measurement scales. *Journal of Clinical Epidemiology*, 66(7), 710-718.
- Goldberg, D., Krueger, R., Andrews, G., & Hobbs, M. (2009). Emotional disorders: cluster 4 of the proposed meta-structure for DSM-V and ICD-11. *Psychological Medicine*, 39(12), 2043-2059.
- *Goldfield, G. S., Henderson, K., Buchholz, A., Obeid, N., Hien, N., & Flament, M. F. (2011). Physical activity and psychological adjustment in adolescents. *Journal of physical activity & health*, 8(2), 157-163.
- Goodin, R. E., Rice, J. M., Parpo, A., & Eriksson, L. (2008). *Discretionary time: A new measure of freedom*. Melbourne: Cambridge University Press.
- Goudas, M., Biddle, S., & Fox, K. (1994). Perceived locus of causality, goal orientations, and perceived competence in school physical education classes. *British Journal of Educational Psychology*, 64(3), 453-463.
- Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: Concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today*, 24, 105-112.

- Gray, E., & Watson, D. (2001). Emotion, mood, and temperament: Similarities, differences, and a synthesis. In R. L. Payne & C. L. Cooper (Eds.), *Emotions at work: Theory, research, and applications in management* (pp. 25-43). West Sussex: John Wiley & Sons Ltd.
- *Griffiths, L. J., Dowda, M., Dezaux, C., & Pate, R. (2010). Associations between sport and screen-entertainment with mental health problems in 5-year-old children. *International Journal of Behavioral Nutrition and Physical Activity*, 7(30). doi: 10.1186/1479-5868-7-30
- Haarasilta, L. M., Marttunen, M. J., Kaprio, J. A., & Aro, H. M. (2004). Correlates of depression in a representative nationwide sample of adolescents (15–19 years) and young adults (20–24 years). *The European Journal of Public Health*, 14(3), 280-285.
- Hagger, M., Chatzisarantis, N. L., Hein, V., Soós, I., Karsai, I., Lintunen, T., & Leemans, S. (2009). Teacher, peer and parent autonomy support in physical education and leisure-time physical activity: A trans-contextual model of motivation in four nations. *Psychology and Health*, 24(6), 689-711.
- Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., Ekelund, U., & Group, L. P. A. S. W. (2012). Global physical activity levels: surveillance progress, pitfalls, and prospects. *The Lancet*, 380(9838), 247-257.
- Hallal, P. C., Victora, C. G., Azevedo, M. R., & Wells, J. C. K. (2006). Adolescent physical activity and health: A systematic review. *Sports Medicine*, 36(12), 1019-1030.
- *Hamer, M., Molloy, G. J., de Oliveira, C., & Demakakos, P. (2009). Leisure time physical activity, risk of depressive symptoms, and inflammatory mediators: The English Longitudinal Study of Ageing. *Psychoneuroendocrinology*, 34(7), 1050-1055. doi: 10.1016/j.psyneuen.2009.02.004

- *Hamer, M., Stamatakis, E., & Steptoe, A. (2009). Dose-response relationship between physical activity and mental health: The Scottish Health Survey. *British Journal of Sports Medicine*, *43*(14), 1111-1114. doi: 10.1136/bjism.2008.046243
- Hardy, L. L., King, L., Espinel, P., Cosgrove, C., & Bauman, A. (2011). *NSW Schools Physical Activity and Nutrition Survey (SPANS) 2010: Full report*. Sydney: NSW Ministry of Health. Retrieved from http://www0.health.nsw.gov.au/pubs/2011/pdf/spans_full.pdf.
- Haskell, W. L., Lee, I.-M., Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B. A., . . . Bauman, A. (2007). Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*, *116*(9), 1081-1093.
- Hassmén, P., Koivula, N., & Uutela, A. (2000). Physical exercise and psychological well-being: a population study in Finland. *Preventive Medicine*, *30*(1), 17-25.
- Headey, B., Kelley, J., & Wearing, A. (1993). Dimensions of mental health: life satisfaction, positive affect, anxiety and depression. *Social Indicators Research*, *29*(1), 63-82.
- Heart Foundation. (2015). Walk yourself happy and healthy. Retrieved July 01, 2016, from <http://walking.heartfoundation.org.au/>
- *Herman, K. M., Hopman, W. M., & Sabiston, C. M. (2015). Physical activity, screen time and self-rated health and mental health in Canadian adolescents. *Preventive Medicine*, *73*, 112-116. doi: 10.1016/j.ypmed.2015.01.030
- Herrman, H., Saxena, S., & Moodie, R. (2005). *Promoting mental health: Concepts, emerging evidence, practice: A report of the World Health Organization, Department of Mental Health and Substance Abuse in collaboration with the Victorian Health Promotion Foundation and the University of Melbourne*. Geneva, Switzerland: World Health Organization.

- Higgins, J. P., & Green, S. (2008). *Cochrane handbook for systematic reviews of interventions (Vol. 5)*. Chichester: Wiley Online Library.
- Higgins, J. P., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *British Medical Journal*, *327*(7414), 557-560.
- Hillman, M. (1993). One false move... An overview of the findings and issues they raise. In M. Hillman (Ed.), *Children, transport and the quality of life* (pp. 7-18). London, England: Policy Studies Institute.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1-55.
- Hufford, M. R. (2007). Special methodological challenges and opportunities in ecological momentary assessment. In A. Stone, S. Shiffman, A. Atienza & L. Nebeling (Eds.), *The science of real-time data capture: Self-reports in health research* (pp. 54-75). New York: Oxford University Press.
- Hume, C., Timperio, A., Veitch, J., Salmon, J., Crawford, D., & Ball, K. (2011). Physical activity, sedentary behaviour, and depressive symptoms among adolescents. *Journal of Physical Activity and Health*, *8*(2), 52-156.
- *Humphreys, D. K., Goodman, A., & Ogilvie, D. (2013). Associations between active commuting and physical and mental wellbeing. *Preventive Medicine*, *57*(2), 135-139. doi: 10.1016/j.ypmed.2013.04.008
- Hunter, J. E., & Schmidt, F. L. (2004). *Methods of meta-analysis: Correcting error and bias in research findings* (2nd ed.). London: Sage Publications.
- *Hyde, A. L., Conroy, D. E., Pincus, A. L., & Ram, N. (2011). Unpacking the feel-good effect of free-time physical activity: Between- and within-person associations with pleasant-activated feeling states. *Journal of Sport and Exercise Psychology*, *33*(6), 884-902. doi: 10.1037/a0023533

- *Im, E. O., Ham, O. K., Chee, E., & Chee, W. (2014). Physical activity and depressive symptoms in four ethnic groups of midlife women. *Western Journal of Nursing Research*. doi: 10.1177/0193945914537123
- *Inal, S., Subasi, F., Ay, S. M., & Hayran, O. (2007). The links between health-related behaviors and life satisfaction in elderly individuals who prefer institutional living. *BMC Health Services Research*, 7(30). doi: 10.1186/1472-6963-7-30
- Irwin, L. G., & Johnson, J. (2005). Interviewing young children: Explicating our practices and dilemmas. *Qualitative Health Research*, 15(6), 821-831.
- *Iwasaki, Y., Zuzanek, J., & Mannell, R. C. (2001). The effects of physically active leisure on stress-health relationships. *Canadian Journal of Public Health*, 92(3), 214-218.
- Janssen, I., & LeBlanc, A. G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity*, 7(40), 1-16.
- Jenkins, R., Baingana, F., Ahmad, R., McDaid, D., & Atun, R. (2011). Mental health and the global agenda: Core conceptual issues. *Mental Health in Family Medicine*, 8, 69-82.
- *Jewett, R., Sabiston, C. M., Brunet, J., O'Loughlin, E. K., Scarapicchia, T., & O'Loughlin, J. (2014). School sport participation during adolescence and mental health in early adulthood. *Journal of Adolescent Health*, 55(5), 640-644. doi: 10.1016/j.jadohealth.2014.04.018
- *Joseph, R. P., Royse, K. E., Benitez, T. J., & Pekmezi, D. W. (2014). Physical activity and quality of life among university students: Exploring self-efficacy, self-esteem, and affect as potential mediators. *Quality of Life Research*, 23(2), 661-669. doi: 10.1007/s11136-013-0492-8

- Jurakić, D., Pedišić, Ž., & Andrijašević, M. (2009). Physical activity of Croatian population: Cross-sectional study using International Physical Activity Questionnaire. *Croatian Medical Journal*, *50*, 165-173.
- *Jurakić, D., Pedišić, Z., & Greblo, Z. (2010). Physical activity in different domains and health-related quality of life: A population-based study. *Quality of Life Research*, *19*(9), 1303-1309. doi: 10.1007/s11136-010-9705-6
- Kerr, J., Rosenberg, D., Sallis, J. F., Saelens, B. E., Frank, L. D., & Conway, T. L. (2006). Active commuting to school: Association with the environment and parental concerns. *Medicine and Science in Sports and Exercise*, *38*(4), 787-794.
- Kessler, R. C., Aguilar-Gaxiola, S., Alonso, J., Chatterji, S., Lee, S., Ormel, J., . . . Wang, P. S. (2009). The global burden of mental disorders: an update from the WHO World Mental Health (WMH) surveys. *Epidemiology and Psychiatric Sciences*, *18*(01), 23-33.
- Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, *62*(6), 593-602.
- *Kilpatrick, M., Sanderson, K., Blizzard, L., Teale, B., & Venn, A. (2013). Cross-sectional associations between sitting at work and psychological distress: Reducing sitting time may benefit mental health. *Mental Health and Physical Activity*, *6*(2), 103-109. doi: 10.1016/j.mhpa.2013.06.004
- *Kim, J., Chun, S., Heo, J., Lee, S., & Han, A. (2014). Contribution of leisure-time physical activity on psychological benefits among elderly immigrants. *Applied research in quality of life*, *11*, 461-470. doi: 10.1007/s11482-014-9374-7

- Kim, K., Shin, Y. J., Nam, J. H., Choi, B. Y., & Kim, M. K. (2008). A dose-response relationship between types of physical activity and distress. *Journal of Korean Medical Science, 23*, 218-225.
- Klein, A., & Moosbrugger, H. (2000). Maximum likelihood estimation of latent interaction effects with the LMS method. *Psychometrika, 65*(4), 457-474.
- *Korniloff, K., Vanhala, M., Kautiainen, H., Koponen, H., Peltonen, M., Mantyselka, P., . . . Hakkinen, A. (2012). Lifetime leisure-time physical activity and the risk of depressive symptoms at the ages of 65-74 years: The FIN-D2D survey. *Preventive Medicine, 54*(5), 313-315. doi: 10.1016/j.ypmed.2012.02.008
- *Kremer, P., Elshaug, C., Leslie, E., Toumbourou, J. W., Patton, G. C., & Williams, J. (2014). Physical activity, leisure-time screen use and depression among children and young adolescents. *Journal of Science and Medicine in Sport, 17*(2), 183-187. doi: 10.1016/j.jsams.2013.03.012
- Krueger, R. F., McGue, M., & Iacono, W. G. (2001). The higher-order structure of common DSM mental disorders: Internalization, externalization, and their connections to personality. *Personality and Individual Differences, 30*(7), 1245-1259.
- *Ku, P. W., Fox, K. R., & Chen, L. J. (2009). Physical activity and depressive symptoms in Taiwanese older adults: A seven-year follow-up study. *Preventive Medicine, 48*(3), 250-255. doi: 10.1016/j.ypmed.2009.01.006
- *Kull, M., Ainsaar, M., Kiive, E., & Raudsepp, L. (2012). Relationship between low depressiveness and domain specific physical activity in women. *Health Care for Women International, 33*(5), 457-472.
- Kvale, S., & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing* (2 ed.). Thousand Oaks, California: Sage Publications.

- *Kwag, K., Martin, P., Russell, D., Franke, W., & Kohut, M. (2011). The impact of perceived stress, social support, and home-based physical activity on mental health among older adults. *International Journal of Aging and Human Development*, 72(2), 137-154. doi: 10.2190/AG.72.2.c
- La Greca, A. M., & Harrison, H. M. (2005). Adolescent peer relations, friendships, and romantic relationships: Do they predict social anxiety and depression? *Journal of Clinical Child and Adolescent Psychology*, 34(1), 49-61.
- Langan, E., Hodge, K., McGowan, S., Carney, S., Saunders, V., & Lonsdale, C. (2015). The influence of controlled motivation alongside autonomous motivation: Maladaptive, buffering, or additive effects? *International Journal of Sport and Exercise Psychology*, 14(1), 1-15.
- Lawlor, D. A., & Hopker, S. W. (2001a). The effectiveness of exercise as an intervention in the management of depression: systematic review and meta-regression analysis of randomised controlled trials. *British Medical Journal*, 322(7289), 763-770.
- Lawlor, D. A., & Hopker, S. W. (2001b). The effectiveness of exercise as an intervention in the management of depression: systematic review and meta-regression analysis of randomised controlled trials. *British Medical Journal*, 322(7289), 763.
- Lawrence, D., Hancock, K. J., & Kisely, S. (2013). The gap in life expectancy from preventable physical illness in psychiatric patients in Western Australia: retrospective analysis of population based registers.
- Lazarus, R., & Cohen-Charash, Y. (2001). Discrete emotions in organizational life. In R. L. Payne & C. L. Cooper (Eds.), *Emotions at work: Theory, research and applications for management* (pp. 45-84). Chichester: John Wiley and Sons.

- LeBlanc, A. G., & Janssen, I. (2010). Difference between self-reported and accelerometer measured moderate-to-vigorous physical activity in youth. *Pediatric Exercise Science, 22*(4), 523-534.
- *Lee, P. L., Lan, W., & Lee, C. C. L. (2012). Physical activity related to depression and predicted mortality risk: Results from the Americans' Changing Lives Study. *Educational gerontology, 38*(10), 678-690. doi: 10.1080/03601277.2011.598410
- Leith, L. M. (2010). *Foundations of exercise and mental health*. Morgantown: Fitness Information Technology Morgantown, WV.
- Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P., . . . Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *Annals of Internal Medicine, 151*(4), W-65-W-94.
- *Lin, L., Halgin, R. P., Well, A. D., & Ockene, I. (2008). The relationship between depression and occupational, household, and leisure-time physical activity. *Journal of Clinical Sport Psychology, 2*(2), 95-107.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Inquiry*. California: Sage Publications.
- Little, T. D., Card, N. A., Bovaird, J. A., Preacher, K. J., & Crandall, C. S. (2007). Structural equation modeling of mediation and moderation with contextual factors. *Modeling Contextual Effects in Longitudinal Studies, 1*.
- Lonsdale, C., Hodge, K., & Rose, E. A. (2008). The Behavioral Regulation in Sport Questionnaire (BRSQ): Instrument development and initial validity evidence. *Journal of Sport & Exercise Psychology, 30*(3), 323.
- Lonsdale, C., Lester, A., Owen, K. B., White, R. L., Moyes, I., Peralta, L., . . . MacMillan, F. (2016). An internet-supported physical activity intervention delivered in secondary schools located in low socio-economic status

- communities: Study protocol for the Activity and Motivation in Physical Education (AMPED) cluster randomized controlled trial. *BioMed Central Public Health*, 16(1).
- Lonsdale, C., Sanders, T., Cohen, K., Parker, P., Noetel, M., & Lubans, D. R. (2016). Scaling-up an efficacious school-based physical activity intervention: Study protocol for the 'Internet-based Professional Learning to help teachers support Activity in Youth' (iPLAY) cluster randomized controlled trial and scale-up implementation evaluation. *BioMed Central Public Health*, *In press*. doi: 10.1186/s12889-016-3243-2
- Lorenc, T., Brunton, G., Oliver, S., Oliver, K., & Oakley, A. (2008). Attitudes to walking and cycling among children, young people and parents: A systematic review. *Journal of Epidemiology and Community Health*, 62(10), 852-857.
- Lubans, D. R., Boreham, C. A., Kelly, P., & Foster, C. E. (2011). The relationship between active travel to school and health-related fitness in children and adolescents: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, 8(5).
- Lubans, D. R., Lonsdale, C., Plotnikoff, R. C., Smith, J., Dally, K., & Morgan, P. J. (2013). Development and evaluation of the motivation to limit screen-time questionnaire (MLSQ) for adolescents. *Preventive Medicine*, 57(5), 561-566.
- Lubans, D. R., Plotnikoff, R. C., & Lubans, N. J. (2012). Review: A systematic review of the impact of physical activity programmes on social and emotional well-being in at-risk youth. *Child and Adolescent Mental Health*, 17(1), 2-13.
- Lubans, D. R., Richards, J., Hillman, C., Faulkner, G., Beauchamp, M., Nilsson, M., . . . Biddle, S. (2016). Physical activity for cognitive and mental health in youth: A systematic review of mechanisms. *Pediatrics*, 138(3), e20161642.

- Lubans, D. R., Smith, J. J., Morgan, P. J., Beauchamp, M. R., Miller, A., Lonsdale, C., . . . Dally, K. (2015). Mediators of psychological well-being in adolescent boys. *Journal of Adolescent Health, 58*(2), 230-236.
- Luhmann, M., Hawkley, L. C., Eid, M., & Cacioppo, J. T. (2012). Time frames and the distinction between affective and cognitive well-being. *Journal of Research in Personality, 46*(4), 431-441.
- *Lutz, R. S., Lochbaum, M. R., Lanning, B., Stinson, L. G., & Brewer, R. (2007). Cross-lagged relationships among leisure-time exercise and perceived stress in blue-collar workers. *Journal of Sport and Exercise Psychology, 29*(6), 687-705.
- Lyubomirsky, S., King, L., & Diener, E. (2005). The benefit of frequent positive affect: Does happiness lead to success? *Psychological Bulletin, 131*(6), 803-855.
- *Malabo, A., Van Eeden, C., & Wissing, M. P. (2007). Sport participation, psychological wellbeing, and psychosocial development in a group of young black adults. *South African Journal of Psychology, 37*(1), 188-206.
- Markland, D., & Tobin, V. (2004). A modification to the behavioural regulation in exercise questionnaire to include an assessment of amotivation. *Journal of Sport and Exercise Psychology, 26*(2), 191-196.
- Marks, D. F., & Yardley, L. (2004). Content and thematic analysis. In D. F. Marks & L. Yardley (Eds.), *Research methods for clinical and health psychology* (pp. 56-69). London: Sage Publications, Ltd.
- Marsh, H. W., Ellis, L. A., Parada, R. H., Richards, G., & Heubeck, B. G. (2005). A short version of the Self Description Questionnaire II: Operationalizing criteria for short-form evaluation with new applications of confirmatory factor analyses. *Psychological Assessment, 17*(1), 81-102.
- *Martin, A., Goryakin, Y., & Suhrcke, M. (2014). Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the

British Household Panel Survey. *Preventive Medicine*, 69, 296-303. doi:

10.1016/j.ypmed.2014.08.023

*Martins, L. C., & Lopes, C. S. (2013). Rank, job stress, psychological distress and physical activity among military personnel. *BioMed Central Public Health*, 13, 716-726. doi: 10.1186/1471-2458-13-716

Mayhew, A. D., Kabir, M., & Ansari, M. T. (2015). Considerations from the risk of bias perspective for updating Cochrane reviews. *Systematic Reviews*, 4(1).

McCann, B., & DeLille, B. (2000). Mean streets 2000: Pedestrian safety, health and federal transportation spending.

McCarthy, P. J., Jones, M. V., & Clark-Carter, D. (2008). Understanding enjoyment in youth sport: A developmental perspective. *Psychology of Sport and Exercise*, 9(2), 142-156.

McCrea, R. L., Berger, Y. G., & King, M. B. (2012). Body mass index and common mental disorders: exploring the shape of the association and its moderation by age, gender and education. *International Journal of Obesity*, 36(3), 414-421.

McDavid, L., Cox, A. E., & Amorose, A. J. (2012). The relative roles of physical education teachers and parents in adolescents' leisure-time physical activity motivation and behavior. *Psychology of Sport and Exercise*, 13(2), 99-107.

McDonald, N. C. (2007). Active transportation to school: Trends among US schoolchildren, 1969–2001. *American Journal of Preventive Medicine*, 32(6), 509-516.

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia Medica*, 22(3), 276-282.

*McKercher, C., Patton, G. C., Schmidt, M. D., Venn, A. J., Dwyer, T., & Sanderson, K. (2013). Physical activity and depression symptom profiles in young men and

- women with major depression. *Psychosomatic Medicine*, 75(4), 366-374. doi:
10.1097/PSY.0b013e31828c4d53
- *McKercher, C., Schmidt, M. D., Sanderson, K., Dwyer, T., & Venn, A. J. (2012).
Physical activity and depressed mood in primary and secondary school-children.
Mental Health and Physical Activity, 5(1), 50-56. doi:
10.1016/j.mhpa.2012.03.004
- *McKercher, C., Schmidt, M. D., Sanderson, K. A., Patton, G. C., Dwyer, T., & Venn,
A. J. (2009). Physical activity and depression in young adults. *American Journal
of Preventive Medicine*, 36(2), 161-164. doi: 10.1016/j.amepre.2008.09.036
- McLoone, J., & Hudson, J. L. (2006). Treating anxiety disorders in a school setting.
Education & Treatment of Children, 29(2), 219-242.
- McMinn, D., Rowe, D. A., Murtagh, S., & Nelson, N. M. (2011). The Strathclyde
Evaluation of Children's Active Travel (SE-CAT): Study rationale and methods.
BioMed Central Public Health, 11(1), 958-969.
- Mensch, B. S., Hewett, P. C., & Erulkar, A. S. (2003). The reporting of sensitive
behavior by adolescents: A methodological experiment in Kenya. *Demography*,
40(2), 247-268.
- Merikangas, K. R., He, J., Burstein, M., Swanson, S. A., Avenevoli, S., Cui, L., . . .
Swendsen, J. (2010). Lifetime prevalence of mental disorders in US adolescents:
results from the National Comorbidity Survey Replication–Adolescent
Supplement (NCS-A). *Journal of the American Academy of Child and
Adolescent Psychiatry*, 49(10), 980-989.
- Merom, D., Tudor-Locke, C., Bauman, A., & Rissel, C. (2006). Active commuting to
school among NSW primary school children: Implications for public health.
Health & Place, 12(4), 678-687.

- Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass Publishers.
- Messick, S. (1980). Test validity and the ethics of assessment. *American Psychologist*, 35(11), 1012.
- Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine*, 151(4), 264-269.
- Moher, D., Schulz, K. F., & Altman, D. G. (2001). The CONSORT statement: Revised recommendations for improving the quality of reports of parallel group randomized trials. *BMC Medical Research Methodology*, 1(1).
- *Molarius, A., Berglund, K., Eriksson, C., Eriksson, H. G., Linden-Bostrom, M., Nordstrom, E., . . . Ydreborg, B. (2009). Mental health symptoms in relation to socio-economic conditions and lifestyle factors--a population-based study in Sweden. *BioMed Central Public Health*, 9, 302-310. doi: 10.1186/1471-2458-9-302
- *Moore, K. A., Babyak, M. A., Wood, C. E., Napolitano, M. A., Khatri, P., Craighead, W. E., . . . Blumenthal, J. A. (1999). The association between physical activity and depression in older depressed adults. *Journal of Aging and Physical Activity*, 7(1), 55-61.
- Morgan, P. J., Barnett, L. M., Cliff, D. P., Okely, A. D., Scott, H. A., Cohen, K. E., & Lubans, D. R. (2013). Fundamental movement skill interventions in youth: A systematic review and meta-analysis. *Pediatrics*, 132(5), 1361-1383.
- Morrison-Beedy, D., Carey, M. P., & Tu, X. (2006). Accuracy of audio computer-assisted self-interviewing (ACASI) and self-administered questionnaires for the assessment of sexual behavior. *AIDS and Behavior*, 10(5), 541-552.

- *Motl, R. W., Birnbaum, A. S., Kubik, M. Y., & Dishman, R. K. (2004). Naturally occurring changes in physical activity are inversely related to depressive symptoms during early adolescence. *Psychosomatic Medicine*, *66*(3), 336-342. doi: 10.1097/01.psy.0000126205.35683.0a
- *Mouchacca, J., Abbott, G. R., & Ball, K. (2013). Associations between psychological stress, eating, physical activity, sedentary behaviours and body weight among women: A longitudinal study. *BioMed Central Public Health*, *13*(1). doi: 10.1186/1471-2458-13-828
- *Mouton, C. P., Calmbach, W. L., Dhanda, R., Espino, D. V., & Hazuda, H. (2000). Barriers and benefits to leisure-time physical activity among older Mexican Americans. *Archives of Family Medicine*, *9*(9), 892-897.
- Muthén, L. K., & Muthén, B. O. (2010). *Mplus statistical analyses with latent variables: User's guide* (6th ed.). Los Angeles, CA: Muthén & Muthén.
- Muthén, L. K., & Muthén, B. O. (2016). Mplus (Version 7.4). Los Angeles, California: Muthén & Muthén. . Retrieved from <https://www.statmodel.com/>
- Mutrie, N. (1997). The therapeutic effects of exercise on the self. In K. R. Fox (Ed.), *The physical self: From motivation to wellbeing* (pp. 75-109). London: John Wiley.
- *Mutrie, N., & Hannah, M. K. (2007). The importance of both setting and intensity of physical activity in relation to non-clinical anxiety and depression. *International Journal of Health Promotion and Education*, *45*(1), 24-32.
- *Nakamura, P. M., Teixeira, I. P., Smirmaul, B. P. C., Sebastião, E., Papini, C. B., Gobbi, S., & Kokubun, E. (2014). Health related quality of life is differently associated with leisure-time physical activity intensities according to gender: A cross-sectional approach. *Health and Quality of Life Outcomes*, *12*(1), 1-10. doi: 10.1186/1477-7525-12-98

- Netz, Y., Wu, M.-J., Becker, B. J., & Tenenbaum, G. (2005). Physical activity and psychological well-being in advanced age: a meta-analysis of intervention studies. *Psychology and Aging, 20*(2), 272-284.
- Newman, J. C., Des Jarlais, D. C., Turner, C. F., Gribble, J., Cooley, P., & Paone, D. (2002). The differential effects of face-to-face and computer interview modes. *Journal Information, 92*(2), 294-297.
- Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.
- *Ohta, M., Mizoue, T., Nishima, N., & Ikeda, M. (2007). Effect of the physical activities in leisure time and commuting to work on mental health. *Journal of Occupational Health, 49*, 46-52.
- Okely, A. D., Salmon, J., Vella, S., Cliff, D., Timperio, A., Tremblay, M., . . . Ridgers, N. (2012). *A systematic review to update the Australian physical activity guidelines for children and young people*. Canberra: Australian Government, Department of Health. Retrieved from <http://www.health.gov.au/internet/main/publishing.nsf/content/health-publhlth-strateg-phys-act-guidelines>.
- Owen, K. B., Parker, P. D., Van Zanden, B., MacMillan, F., Astell-Burt, T., & Lonsdale, C. (2016). Physical activity and school engagement in youth: A systematic review and meta-analysis. *Educational Psychologist, 1*-17.
- Owen, K. B., Smith, J., Lubans, D. R., Ng, J. Y. Y., & Lonsdale, C. (2014). Self-determined motivation and physical activity in children and adolescents: A systematic review and meta-analysis. *Preventive Medicine, 67*, 270-279.
- *Pagán, R. (2014). How do leisure activities impact on life satisfaction? Evidence for German people with disabilities. *Applied research in quality of life, 10*, 557-572.
doi: 10.1007/s11482-014-9333-3

- Pahkala, K., Heinonen, O. J., Lagström, H., Hakala, P., Sillanmäki, L., & Simell, O. (2007). Leisure-time physical activity of 13-year-old adolescents. *Scandinavian Journal of Medicine and Science in Sports, 17*, 324-330.
- Paluska, S. A., & Schwenk, T. L. (2000). Physical activity and mental health. *Sports Medicine, 29*(3), 167-180.
- Parfitt, G., Rose, E. A., & Burgess, W. M. (2006). The psychological and physiological responses of sedentary individuals to prescribed and preferred intensity exercise. *British Journal of Health Psychology, 11*(1), 39-53.
- *Pasco, J. A., Williams, L. J., Jacka, F. N., Henry, M. J., Coulson, C. E., Brennan, S. L., . . . Berk, M. (2011). Habitual physical activity and the risk for depressive and anxiety disorders among older men and women. *International Psychogeriatrics, 23*(2), 292-298. doi: 10.1017/S1041610210001833
- *Pastor, Y., Balaguer, I., Pons, D., & Garcia-Merita, M. (2003). Testing direct and indirect effects of sports participation on perceived health in Spanish adolescents between 15 and 18 years of age. *Journal of Adolescence, 26*(6), 717-730.
- Pate, R. R., Pratt, M., Blair, S. N., Haskell, W. L., Macera, C. A., Bouchard, C., . . . King, A. C. (1995). Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association, 273*(5), 402-407.
- Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). Thousand Oaks, California: Sage Publications.
- Pawson, R., & Tilley, N. (1997). *Realistic evaluation*. Thousand Oaks, California: Sage.
- *Pedišić, Z., Greblo, Z., Phongsavan, P., Milton, K., & Bauman, A. E. (2015). Are total, intensity- and domain-specific physical activity levels associated with life

satisfaction among university students? *PloS One*, *10*(2), e0118137. doi:
10.1371/journal.pone.0118137

- *Peeters, G., Van Gellecum, Y. R., Van Uffelen, J. G. Z., Burton, N. W., & Brown, W. J. (2014). Contribution of house and garden work to the association between physical activity and well-being in young, mid-aged and older women. *British Journal of Sports Medicine*, *48*(12), 996-1001. doi: 10.1136/bjsports-2012-091103
- Peluso, M. A. M., & Andrade, L. H. S. G. d. (2005). Physical activity and mental health: the association between exercise and mood. *Clinics*, *60*(1), 61-70.
- *Petronyte, G., & Zaborskis, A. (2009). The influence of individual and regional factors on association between leisure time physical activity and psychological complaints among adolescents in europe. *Central European Journal of Public Health*, *17*(4), 215-219.
- Petruzzello, S. J., Landers, D. M., Hatfield, B. D., Kubitz, K. A., & Salazar, W. (1991). A meta-analysis on the anxiety-reducing effects of acute and chronic exercise. *Sports Medicine*, *11*(3), 143-182.
- *Pickett, K., Yardley, L., & Kendrick, T. (2012). Physical activity and depression: A multiple mediation analysis. *Mental Health and Physical Activity*, *5*(2), 125-134. doi: 10.1016/j.mhpa.2012.10.001
- Pink, B. (2011). *Socio-economic indexes for areas (SEIFA): Technical Paper*. Canberra: Australian Bureau of Statistics. Retrieved from [http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/22CEDA8038AF7A0DCA257B3B00116E34/\\$File/2033.0.55.001%20seifa%202011%20technical%20paper.pdf](http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/22CEDA8038AF7A0DCA257B3B00116E34/$File/2033.0.55.001%20seifa%202011%20technical%20paper.pdf).

- Plotnikoff, R. C., Costigan, S. A., Karunamuni, N., & Lubans, D. R. (2013). Social cognitive theories used to explain physical activity behavior in adolescents: A systematic review and meta-analysis. *Preventive Medicine, 56*(5), 245-253.
- Pratt, M., Macera, C. A., Sallis, J. F., O'Donnell, M., & Frank, L. D. (2004). Economic interventions to promote physical activity: Application of the SLOTH model. *American Journal of Preventive Medicine, 27*(3), 136-145.
- Prentice, D. A., & Miller, D. T. (1992). When small effects are impressive. *Psychological Bulletin, 112*(1), 160-164.
- Prince, M., Patel, V., Saxena, S., Maj, M., Maselko, J., Phillips, M. R., & Rahman, A. (2007). Global mental health 1: No health without mental health. *Lancet, 370*, 859-877.
- Prince, S. A., Adamo, K. B., Hamel, M. E., Hardt, J., Gorber, S. C., & Tremblay, M. (2008). A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 5*(56).
- Public Health Agency (Producer). (2010). Physical activity - It all adds up! [television advertisement]. Retrieved from <https://www.youtube.com/watch?v=NLHYnRCd8sA>.
- *Purakom, A., Nakornkhet, K., Tanomsuk, M., Pupanead, S., André, S., & Joana, C. (2014). Associations between physical activity, functional fitness, and mental health among older adults in Nakornpathom, Thailand. *Asian Journal of Exercise & Sports Science, 11*(2), 25-35.
- R Core Team. (2016). R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from <https://www.R-project.org/>

- Raykov, T. (1997). Estimation of composite reliability for congeneric measures. *Applied Psychological Measurement, 21*(2), 173-184.
- Raykov, T. (2012). Scale reliability evaluation with LISREL 8.50.
- Reeve, J., Nix, G., & Hamm, D. (2003). Testing models of the experience of self-determination in intrinsic motivation and the conundrum of choice. *Journal of Educational Psychology, 95*(2), 375.
- Reiss, F. (2013). Socioeconomic inequalities and mental health problems in children and adolescents: a systematic review. *Social Science and Medicine, 90*, 24-31.
- Richman, W. L., Weisband, S., Kiesler, S., & Drasgow, F. (1999). A meta-analytic study of social desirability distortion in computer-administered questionnaires, traditional questionnaires, and interviews. *Journal of Applied Psychology, 84*(5), 754-775.
- Ridgers, N. D., & Fairclough, S. (2011). Assessing free-living physical activity using accelerometry: practical issues for researchers and practitioners. *European journal of sport science, 11*(3), 205-213.
- *Rocha, S. V., de Araújo, T. M., de Almeida, M. M. G., & Virtuoso Jr, J. S. (2012). Practice of physical activity during leisure time and common mental disorders among residents of a municipality of Northeast Brazil. *Revista Brasileira de Epidemiologia, 15*(4), 871-883. doi: 10.1590/S1415-790X2012000400017
- Rodriguez, D. A., Cho, G., Elder, J. P., Conway, T. L., Evenson, K. R., Ghosh-Dastidar, B., . . . Pickrell, J. (2012). Identifying walking trips from GPS and accelerometer data in adolescent females. *Journal of physical activity & health, 9*(3), 421-431.
- Rose, E. A., & Parfitt, G. (2007a). Psychological responses to prescribed and self-selected exercise intensity: The how and why of individual feeling states. *Journal of Sport and Exercise Psychology, 29*, 281-309.

- Rose, E. A., & Parfitt, G. (2007b). A quantitative analysis and qualitative explanation of the individual differences in affective responses to prescribed and self-selected exercise intensities. *Journal of Sport and Exercise Psychology*, 29(3), 281.
- Rosenthal, R. (1979). The file drawer problem and tolerance for null results. *Psychological Bulletin*, 86(3), 638-641.
- Rosenthal, R. (1991). *Meta-analytic procedures for social research*. Newbury Park: Sage.
- Rothman, K. J., Greenland, S., & Lash, T. L. (2008). *Modern epidemiology*. Philadelphia: Lippincott Williams & Wilkins.
- Rücker, G., Schwarzer, G., Carpenter, J. R., & Schumacher, M. (2008). Undue reliance on I² in assessing heterogeneity may mislead. *BMC Medical Research Methodology*, 8(1), 79-87.
- Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality*, 63(3), 397-427.
- Ryan, R. M., & Deci, E. L. (2000a). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, 25(1), 54-67.
- Ryan, R. M., & Deci, E. L. (2000b). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68.
- Ryan, R. M., & Deci, E. L. (2002). An overview of self-determination theory: An orgasmic-dialectical perspective. In R. M. Ryan & E. L. Deci (Eds.), *Handbook of self-determination research* (pp. 3-33). Rochester, New York: The University of Rochester Press.

- Ryan, R. M., & Deci, E. L. (2006). Self-regulation and the problem of human autonomy: does psychology need choice, self-determination, and will? *Journal of Personality, 74*(6), 1557-1586.
- *Sabiston, C. M., O'Loughlin, E., Brunet, J., Chaiton, M., Low, N. C., Barnett, T., & O'Loughlin, J. (2013). Linking depression symptom trajectories in adolescence to physical activity and team sports participation in young adults. *Preventive Medicine, 56*(2), 95-98. doi: 10.1016/j.ypmed.2012.11.013
- Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annual Review of Public Health, 27*, 297-322.
- Sallis, J. F., McKenzie, T. L., Beets, M. W., Beighle, A., Erwin, H., & Lee, S. (2012). Physical education's role in public health: Steps forward and backward over 20 years and HOPE for the future. *Research Quarterly for Exercise and Sport, 83*(2), 125-135.
- Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise, 32*(5), 963-975.
- Sallis, J. F., & Saelens, B. E. (2000). Assessment of physical activity by self-report: status, limitations, and future directions. *Research Quarterly for Exercise and Sport, 71*(sup2), 1-14.
- Salvo, D., Torres, C., Villa, U., Rivera, J. A., Sarmiento, O. L., Reis, R. S., & Pratt, M. (2015). Accelerometer-based physical activity levels among Mexican adults and their relation with sociodemographic characteristics and BMI: a cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity, 12*(1), 1.

- *Sanchez-Villegas, A., Ara, I., Dierssen, T., Dela Fuente, C., Ruano, C., & Martínez-González, M. A. (2012). Physical activity during leisure time and quality of life in a Spanish cohort: SUN (Seguimiento Universidad de Navarra) Project. *British Journal of Sports Medicine*, *46*(6), 443-448.
- *Sanchez-Villegas, A., Ara, I., Guillén-Grima, F., Bes-Rastrollo, M., Varo-Cenarruzabeitia, J. J., & Martínez-González, M. A. (2008). Physical activity, sedentary index, and mental disorders in the sun cohort study. *Medicine and Science in Sports and Exercise*, *40*(5), 827-834. doi: 10.1249/MSS.0b013e31816348b9
- Saris, W., Blair, S., Van Baak, M., Eaton, S., Davies, P., Di Pietro, L., . . . Swinburn, B. (2003). How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and consensus statement. *Obesity Reviews*, *4*(2), 101-114.
- *Sasidharan, V., Payne, L., Orsega-Smith, E., & Godbey, G. (2006). Older adults' physical activity participation and perceptions of wellbeing: Examining the role of social support for leisure. *Managing Leisure*, *11*(3), 164-185.
- Sawyer, M. G., Arney, F. M., Baghurst, P. A., Clark, J. J., Graetz, B. W., Kosky, R. J., . . . Zubrick, S. R. (2000). *Child and adolescent component of the National Survey of Mental Health and Well-being: Mental Health of Young People in Australia*. Canberra: Commonwealth Department of Health and Aged Care. Retrieved from [http://www.health.gov.au/internet/main/publishing.nsf/content/70DA14F816CC7A8FCA25728800104564/\\$File/young.pdf](http://www.health.gov.au/internet/main/publishing.nsf/content/70DA14F816CC7A8FCA25728800104564/$File/young.pdf).
- Saxena, S., Jané Llopis, E., & Hosman, C. (2006). Prevention of mental and behavioral disorders: implications for policy and practice. *World Psychiatry*, *5*(1), 5-14.

- Schipperijn, J., Andersen, H. B., Klinker, C. D., Rask, S., Pawlowski, C., Sylvest, C., & Troelsen, J. (2012). Locating schoolyard physical activity—Using GPS, accelerometry and GIS. *Journal of Science and Medicine in Sport, 15*, S255.
- *Schnohr, P., Kristensen, T. S., Prescott, E., & Scharling, H. (2005). Stress and life dissatisfaction are inversely associated with jogging and other types of physical activity in leisure time—The Copenhagen City Heart Study. *Scandinavian Journal of Medicine and Science in Sports, 15*(2), 107-112.
- Schranz, N., Olds, T., Cliff, D., Davern, M., Engelen, L., Giles-Corti, B., . . . Hills, A. (2014). Results from Australia's 2014 report card on physical activity for children and youth. *Journal of Physical Activity and Health, 11*(Supp 1), S21-S25.
- Seippel, Ø. (2006). The meanings of sport: Fun, health, beauty or community? *Sport in Society, 9*(1), 51-70.
- Seligman, M. (1975). *Helplessness: On depression, development, and death. A series of books in psychology*. New York: WH Freeman/Times Books/Henry Holt & Co.
- *Serrano-Sanchez, J. A., Lera-Navarro, A., & Espino-Torón, L. (2013). Physical activity and differences of functional fitness and quality of life in older males. *Revista Internacional de Medicina y Ciencias de la Actividad Fisica y del Deporte, 13*(49), 87-105.
- Shephard, R. J. (2003). Limits to the measurement of habitual physical activity by questionnaires. *British Journal of Sports Medicine, 37*, 197-206.
- *Sieverdes, J. C., Ray, B. M., Sui, X., Lee, D. C., Hand, G. A., Baruth, M., & Blair, S. N. (2012). Association between leisure time physical activity and depressive symptoms in men. *Medicine and Science in Sports and Exercise, 44*(2), 260-265.
doi: 10.1249/MSS.0b013e31822e00a6

- Singh, A., Uijtdewilligen, L., Twisk, J. W., Van Mechelen, W., & Chinapaw, M. J. (2012). Physical activity and performance at school: A systematic review of the literature including a methodological quality assessment. *Archives of Pediatrics and Adolescent Medicine, 166*(1), 49-55.
- Smith, M. P., Berdel, D., Nowak, D., Heinrich, J., & Schulz, H. (2016). Physical activity levels and domains assessed by accelerometry in German adolescents from GINIplus and LISApus. *PloS One, 11*(3), e0152217.
- Smith, P. G., & Day, N. E. (1984). The design of case-control studies: the influence of confounding and interaction effects. *International Journal of Epidemiology, 13*(3), 356-365.
- Sohn, A. J., Hasnain, M., & Sinacore, J. M. (2007). Impact of exercise (walking) on blood pressure levels in African American adults with newly diagnosed hypertension. *Ethnicity and Disease, 17*(3), 503-507.
- Standage, M., Duda, J. L., & Ntoumanis, N. (2006). Students' motivational processes and their relationship to teacher ratings in school physical education: A self-determination theory approach. *Research Quarterly for Exercise and Sport, 77*(1), 100-110.
- *Stephens, T. (1988). Physical activity and mental health in the United States and Canada: evidence from four population surveys. *Preventive Medicine, 17*(1), 35-47.
- *Surkan, P. J., Ryan, L. M., Bidwell, H. W., Brooks, D. R., Peterson, K. E., & Gillman, M. W. (2005). Psychosocial correlates of leisure-time physical activity in urban working-class adults. *Journal of physical activity & health, 2*(4), 397-411.
- Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston: Pearson.

- Tao, F. B., Xu, M. L., Kim, S. D., Sun, Y., Su, P. Y., & Huang, K. (2007). Physical activity might not be the protective factor for health risk behaviours and psychopathological symptoms in adolescents. *Journal of Paediatrics and Child Health*, *43*(11), 762-767.
- Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1).
- *Tessier, S., Vuillemin, A., Bertrais, S., Boini, S., Le Bihan, E., Oppert, J. M., . . . Briançon, S. (2007). Association between leisure-time physical activity and health-related quality of life changes over time. *Preventive Medicine*, *44*(3), 202-208. doi: 10.1016/j.ypmed.2006.11.012
- *Teychenne, M., Ball, K., & Salmon, J. (2008a). Associations between physical activity and depressive symptoms in women. *International Journal of Behavioral Nutrition and Physical Activity*, *5*. doi: 10.1186/1479-5868-5-27
- Teychenne, M., Ball, K., & Salmon, J. (2008b). Physical activity and likelihood of depression in adults: A review. *Preventive Medicine*, *46*, 397-411.
- *Teychenne, M., Ball, K., & Salmon, J. (2010). Physical activity, sedentary behaviour and depression among disadvantaged women. *Health Education Research*, *25*(4), 632-644.
- *Teychenne, M., Torres, S., McNaughton, S. A., Salmon, J., & Ball, K. (2014). Mediators of the relationship between sedentary behavior and depressive symptoms amongst disadvantaged women. *Mental Health and Physical Activity*, *7*(1), 30-36. doi: 10.1016/j.mhpa.2013.09.005
- The Department of Premier and Cabinet. (2015). Move more, sit less. Retrieved July 01, 2016, from http://www.getmoving.tas.gov.au/move_more_sit_less.

- Thøgersen-Ntoumani, C., Fox, K. R., & Ntoumanis, N. (2005). Relationships between exercise and three components of mental well-being in corporate employees. *Psychology of Sport and Exercise, 6*(6), 609-627. doi: 10.1016/j.psychsport.2004.12.004
- Thompson-Coon, J., Boddy, K., Stein, K., Whear, R., Barton, J., & Depledge, M. H. (2011). Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors? A systematic review. *Environmental Science & Technology, 45*, 1761-1772.
- Tremblay, M., & Haskell, W. (2012). From science to physical activity guidelines. In C. Bouchard, S. N. Blair & W. L. Haskell (Eds.), *Physical activity and health* (Vol. 2). Champaign: Human Kinetics.
- Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., & McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports and Exercise, 40*(1), 181-188.
- Trost, S. G., Pate, R. R., Sallis, J. F., Freedson, P. S., Taylor, W. C., Dowda, M., & Sirard, J. (2002). Age and gender differences in objectively measured physical activity in youth. *Medicine and Science in Sports and Exercise, 34*(2), 350-355.
- Trumbo, P., Schlicker, S., Yates, A. A., & Poos, M. (2002). Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids. *Journal of the American Dietetic Association, 102*(11), 1621-1630.
- Tut, T. G., Wang, J. L., & Lim, C. C. L. (2000). Negative association between T102C polymorphism at the 5-HT_{2A} receptor gene and bipolar affective disorders in Singaporean Chinese. *Journal of Affective Disorders, 58*, 211-214.
- Ussher, M. H., Owen, C. G., Cook, D. G., & Whincup, P. H. (2007). The relationship between physical activity, sedentary behaviour and psychological wellbeing

- among adolescents. *Social Psychiatry and Psychiatric Epidemiology*, 42(10), 851-856.
- Vacha-Haase, T., & Thompson, B. (2004). How to estimate and interpret various effect sizes. *Journal of Counseling Psychology*, 51(4), 473-481.
- *Valois, R. F., Zullig, K. J., Huebner, E. S., & Drane, J. W. (2004). Physical activity behaviors and perceived life satisfaction among public high school adolescents. *Journal of School Health*, 74(2), 59-65.
- Van der Ploeg, H. P., Merom, D., Corpuz, G., & Bauman, A. E. (2008). Trends in Australian children traveling to school 1971–2003: Burning petrol or carbohydrates? *Preventive Medicine*, 46(1), 60-62.
- Vansteenkiste, M., Lens, W., De Witte, S., De Witte, H., & Deci, E. L. (2004). The ‘why’ and ‘why not’ of job search behaviour: Their relation to searching, unemployment experience, and well-being. *European Journal of Social Psychology*, 34(3), 345-363.
- Von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., Vandenbroucke, J. P., & Initiative, S. (2007). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. *Preventive Medicine*, 45(4), 247-251.
- *Vuillemin, A., Boini, S., Bertrais, S., Tessier, S., Oppert, J. M., Hercberg, S., . . . Briançon, S. (2005). Leisure time physical activity and health-related quality of life. *Preventive Medicine*, 41(2), 562-569. doi: 10.1016/j.ypmed.2005.01.006
- *Wang, F., DesMeules, M., Luo, W., Dai, S., Lagace, C., & Morrison, H. (2011). Leisure-Time Physical Activity and Marital Status in Relation to Depression Between Men and Women: A Prospective Study. *Health Psychology*, 30(2), 204-211. doi: 10.1037/a0022434

- Warburton, D. E., Katzmarzyk, P. T., Rhodes, R. E., & Shephard, R. J. (2007). Evidence-informed physical activity guidelines for Canadian adults This article is part of a supplement entitled Advancing physical activity measurement and guidelines in Canada: A scientific review and evidence-based foundation for the future of Canadian physical activity guidelines co-published by Applied Physiology, Nutrition, and Metabolism and the Canadian Journal of Public Health. . *Applied Physiology, Nutrition, and Metabolism*, 32(S2E), S16-S68.
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063.
- Watson, P. D., Denny, S. J., Adair, V., Ameratunga, S. N., Clark, T. C., Crengle, S. M., . . . Sporle, A. A. (2001). Adolescents' perceptions of a health survey using multimedia computer-assisted self-administered interview. *Australian and New Zealand Journal of Public Health*, 25(6), 520-524.
- Webb, P. M., Zimet, G. D., Fortenberry, J. D., & Blythe, M. J. (1999). Comparability of a computer-assisted versus written method for collecting health behavior information from adolescent patients. *Journal of Adolescent Health*, 24(6), 383-388.
- Weed, M. (2009). Research quality considerations for grounded theory research in sport and exercise psychology. *Psychology of Sport and Exercise*, 10(5), 502-510.
- Weinstein, N., & Ryan, R. M. (2010). When helping helps: autonomous motivation for prosocial behavior and its influence on well-being for the helper and recipient. *Journal of Personality and Social Psychology*, 98(2), 222-244.
- Welk, G. (2002). *Physical activity assessments for health-related research*. Champaign: Human Kinetics.

- Wen, L. M., Fry, D., Rissel, C., Dirkis, H., Balafas, A., & Merom, D. (2008). Factors associated with children being driven to school: Implications for walk to school programs. *Health Education Research, 23*(2), 325-334.
- *Wendel-Vos, G. C. W., Schuit, A. J., Tijhuis, M. A. R., & Kromhout, D. (2004). Leisure time physical activity and health-related quality of life: Cross-sectional and longitudinal associations. *Quality of Life Research, 13*(3), 667-677. doi: 10.1023/B:QURE.0000021313.51397.33
- Whiteford, H. A., Degenhardt, L., Rehm, J., Baxter, A. J., Ferrari, A. J., Erskine, H. E., . . . Johns, N. (2013). Global burden of disease attributable to mental and substance use disorders: Findings from the Global Burden of Disease Study 2010. *The Lancet, 382*(9904), 1575-1586.
- Wickel, E. E., & Eisenmann, J. C. (2007). Contribution of youth sport to total daily physical activity among 6-to 12-yr-old boys. *Medicine and Science in Sports and Exercise, 39*(9), 1493-1500.
- *Wijndaele, K., Matton, L., Duvigneaud, N., Lefevre, J., De Bourdeaudhuij, I., Duquet, W., . . . Philippaerts, R. M. (2007). Association between leisure time physical activity and stress, social support and coping: A cluster-analytical approach. *Psychology of Sport and Exercise, 8*(4), 425-440. doi: 10.1016/j.psychsport.2006.08.001
- Williams, G. C. (2002). Improving patients health through supporting the autonomy of patients and providers. In R. M. Ryan & E. L. Deci (Eds.), *Handbook of self-determination research* (pp. 233-254). Rochester, New York: The University of Rochester Press.
- Windle, G., Hughes, D., Linck, P., Russell, I., & Woods, B. (2010). Is exercise effective in promoting mental well-being in older age? A systematic review. *Aging & Mental Health, 14*(6), 652-669.

- World Health Organization. (2001). *The World Health Report: 2001: Mental Health: New Understanding, New Hope*. Geneva, Switzerland: World Health Organization. Retrieved from http://www.who.int/whr/2001/en/whr01_en.pdf.
- World Health Organization. (2004). *Promoting mental health: Concepts, emerging evidence, practice. Summary report*. Geneva, Switzerland: World Health Organization. Retrieved from http://www.who.int/mental_health/evidence/en/promoting_mhh.pdf.
- World Health Organization. (2010). *Global recommendations on physical activity for health*. Geneva, Switzerland: WHO Press. Retrieved from http://whqlibdoc.who.int/publications/2010/9789241599979_eng.pdf.
- World Health Organization. (2012). *Definition of an older or elderly person*. Geneva, Switzerland: World Health Organization. Retrieved from <http://www.who.int/healthinfo/survey/ageingdefnolder/en/>.
- *Yang, X., Telama, R., Hirvensalo, M., Hintsanen, M., Hintsanen, T., Pulkki-Råback, L., . . . Raitakari, O. T. (2012). Moderating effects of leisure-time physical activity on the association between job strain and depressive symptoms: The cardiovascular risk in young finns study. *Journal of Occupational and Environmental Medicine*, 54(3), 303-309. doi: 10.1097/JOM.0b013e318240df39
- *Zullig, K. J., & White, R. J. (2011). Physical activity, life satisfaction, and self-rated health of middle school students. *Applied research in quality of life*, 6(3), 277-289. doi: 10.1007/s11482-010-9129-z

CHAPTER 7: Appendices

Appendix A: Additional Information Regarding Methodology and Design

This appendix discusses methodological aspects relating to the overall thesis as well as each specific study that are not discussed in detail in Chapters 2-5. Presented first is the conceptual framework of the overall thesis, and the methodological approach undertaken in order to examine the concepts and relationships shown in the conceptual framework. Next, the sampling procedures for each individual study are highlighted, including ethics approval. Finally, data analysis techniques common to the overall thesis are described generally (i.e., missing data and structural equation modelling) before a more detailed presentation of the specific data analysis techniques is discussed in relation to each study.

Conceptual Framework

Figure A1 highlights the main concepts investigated within this thesis, which are: domain-specific physical activity (i.e., leisure-time physical activity, active travel, physical education, household physical activity, work-related physical activity, and school sport), mental health including aspects of both positive mental health and mental ill-health, and self-determined motivation. Figure A1 also highlights that this thesis investigated the relationships between domain-specific physical activity and mental health, as well as the role motivation plays in some of the aforementioned relationships.

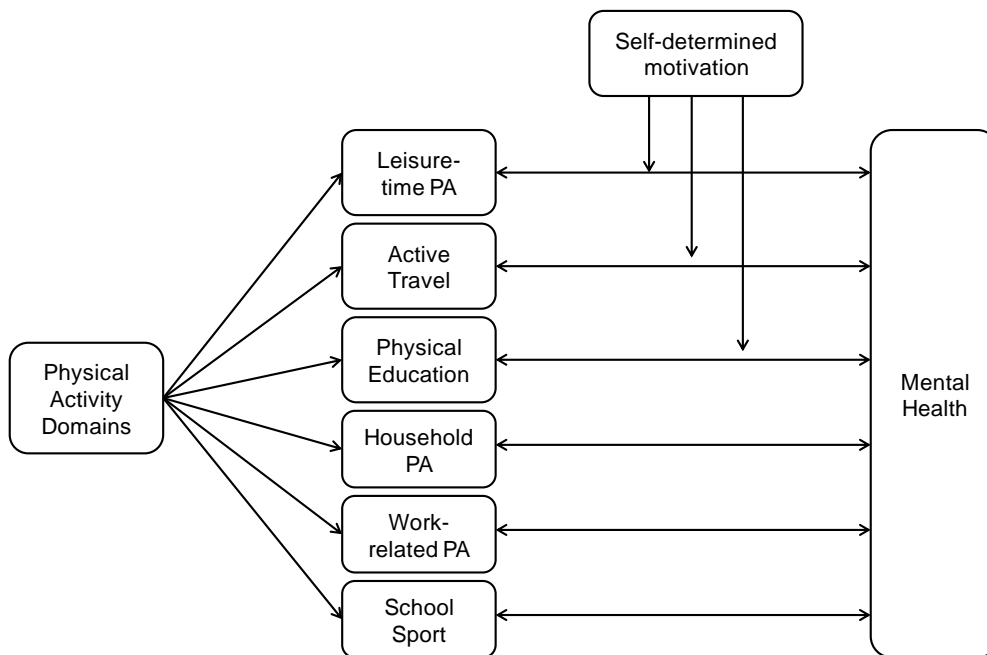


Figure A1. Conceptual framework of the main concepts and relationships investigated within this thesis.

Methodological Approach

The premise of mixed methods research is that the combination of qualitative and quantitative methods provides a deeper understanding of research problems compared to either approach alone (Creswell & Clark, 2007). Qualitative methods are important in understanding the mechanisms which underlie the effect of physical activity on mental health (Mutrie, 1997) and are particularly useful in understanding this relationship in detail in a variety of contexts (Faulkner & Biddle, 2004). Quantitative methods can investigate the role of a moderator variable (i.e., self-determined motivation) in the relationship between physical activity and mental health in a larger population (Cerin, 2010). As such, data were gathered using both qualitative and quantitative methods to develop a cohesive understanding of the relationships between domain-specific physical activity and mental health.

Data for this thesis were largely collected as part of a broader project entitled the ‘Activity and Motivation in Physical Education’ (AMPED) cluster randomised controlled trial, which was funded by an Australian Research Council Discovery Grant (DP130104659). Study 3 and Study 4 used the cross-sectional data from the first time point of AMPED data collection which took place between February and April, 2014. Study 2, however, recruited a different sample of students.

Ethics Approval

Ethics approval was received from the Western Sydney University Human Research Ethics Committee (H9171), the Australian Catholic University Human Research Ethics Committee (2014 185N; see Appendix A), and the New South Wales Department of Education (2013162). Parental consent and participant assent were obtained from each student participating in each study.

Sampling Procedures

A total of 14 government-funded secondary schools in Western Sydney, Australia participated in the AMPED trial. All 14 schools were situated in low socioeconomic areas, with an Australian Bureau of Statistics Index of Relative Socio-economic Disadvantage less than or equal to five (Pink, 2011). All students in Year 8 in 2014 were eligible to participate and over 80% of students across the 14 schools provided consent. However, as these students were not used for all the studies within this thesis, the sampling procedures will be discussed separately for each study.

Study 1

As Study 1 was a meta-analysis no participants were recruited for this study.

Study 2

Three independent secondary schools in Sydney, Australia were sent an information sheet and invited to participate. Two of the schools expressed interest and the principal signed consent for the school to participate. All PDHPE teachers at the two schools who had a Year 9 class in 2013 also agreed to participate and signed a teacher consent form. This form was only to conduct research during their class time, not to collect any data from the teachers themselves. All Year 9 students at both schools were invited to participate.

Study 3

Phase 1 – Self-determination theory experts. A number of keywords relating to self-determination theory were entered into a number of databases (i.e., SCOPUS, SportDISCUS, PubMed, PsycINFO, and Google Scholar) to identify key researchers in the area of self-determination theory. Physical activity terms were also searched alongside self-determination theory keywords. Additionally, the reference lists of key papers on physical activity and self-determination theory were investigated for potential self-determination theory experts. Through this process 36 researchers were identified, all of whom have peer reviewed papers in the area of self-determination theory. All 36 experts were contacted and 25 agreed to take part and completed the expert review process.

Phase 2 – Initial sample. The initial sample was a convenience sample from two independent secondary schools. These two schools already held a professional relationship with the University and all Year 7 and 8 students in 2013 were eligible to participate.

Phase 3 – Cross validation sample. The cross validation sample consisted of the baseline AMPED sample.

Study 4

The baseline AMPED participants were also used in Study 4.

Data Analysis

Missing Data

While traditional methods of handling missing data involve deletion and imputing mean values, a full information maximum likelihood method accounts for missing data without deleting participants and reducing the sample size (Baraldi & Enders, 2010). While this method does not impute the missing values, it uses all available data to calculate parameter estimates and standard errors (Baraldi & Enders, 2010). This retains power and provides more accurate estimations (Baraldi & Enders, 2010). Full information maximum likelihood was used to account for missing values in Study 3 and Study 4. Missing data was not an issue for Study 1 or Study 2.

Structural Equation Modelling (SEM)

Structural Equation Modelling is an “umbrella” set of modelling techniques for conducting multivariate data analysis (Bowen & Guo, 2011). Structural equation modelling allows complex models to be tested with numerous associations between variables being simultaneously estimated (Bowen & Guo, 2011). As such, SEM was employed in Studies 1, 3, and 4. However, as SEM is an overarching technique, the specific applications of SEM are discussed in relation to each study.

Study 1

Adjusting r for measurement error. When using questionnaires to measure latent variables, the true-score theory suggests that the observed value in a study population is equal to a true value plus measurement error associated with the measurements used (Charles, 2005). While the true score cannot be perfectly measured,

understanding the influence of measurement error on the observed score is essential in a meta-analysis, given that results from different studies are influenced by different amounts of measurement error. Scales with a higher reliability indicate that a smaller portion of the variance in the observed score is due to measurement error (Charles, 2005). Therefore, results based on scales with poor and strong reliabilities are not very comparable. To account for this in a meta-analysis, Hunter and Schmidt (2004) suggest correcting effect sizes for attenuation, which is the underestimation of an observed score due to unreliability of the study measurements. While the “true-score” in the population cannot be ascertained, dividing the observed score by the square root of the reliability of the measures used makes the individual study results more comparable, regardless of the reliability of different measures (Charles, 2005; Hunter & Schmidt, 2004).

The following equation demonstrates how the adjusted correlation is equal to the observed correlation (r_{xy}) divided by the square root of the reliability of the independent variable measure (r_{xx}) and the dependent variable measure (r_{yy}) (Charles, 2005; Hunter & Schmidt, 2004). Therefore, this formula was used to adjust individual effect sizes for measurement error (Charles, 2005; Hunter & Schmidt, 2004).

$$r_{xyc} = \frac{r_{xy}}{\sqrt{r_{xx}}\sqrt{r_{yy}}}$$

r_{xyc} = the corrected correlation in the study sample

r_{xy} = is the observed correlation in the study

r_{xx} = reliability for independent variable

r_{yy} = the reliability for dependent variable

Transforming r to Fisher’s z . While correlation effect sizes are easily interpreted and represent the continuous nature of, and association between, two

variables, as r becomes closer to 1 or -1, the distribution becomes more skewed (Rosenthal, 1991). To address this issue, R. A. Fisher (1925) recommended transforming r into Fisher's z , which is nearly normally distributed. The following formula by Borenstein et al. (2009) was used to do this:

$$z = 0.5 \times \ln\left(\frac{1+r}{1-r}\right)$$

Meta-analytic structural equation modelling. A meta-analytic structural equation model combines meta-analytic techniques with SEM techniques (M. W. L. Cheung, 2015a). Formulating the meta-analysis as a structural equation model allowed the synthesis of nested data (i.e., numerous effect sizes within the primary studies; M. W. L. Cheung, 2015a). Advantages of conducting meta-analyses through SEM include more precise estimates due to an increased sample size, obtaining a 95% CI for parameter estimates, and the potential to test moderation models (M. W. L. Cheung, 2015a).

Multilevel meta-analysis. Given that the primary objective of the meta-analysis in Study 1 was to investigate the relationship between physical activity within a number of life domains and mental health, the majority of studies included multiple effect sizes, either within different physical activity domains, or in terms of different mental health outcomes. While classic meta-analysis models assume independence, multiple effect sizes from the same study are likely to be correlated as the same sample has contributed to multiple effect sizes, and therefore, the effect sizes are not independent (Borenstein et al., 2009; H. M. Cooper, 1998). This is because outcomes such as anxiety and depression are more likely to be higher correlated within the same sample than between different samples (Borenstein et al., 2009).

There are three potential options for handling dependence among effect sizes. The first, and simplest, is to ignore the dependence. However, the regression coefficients are likely to be biased and the standard errors and parameter estimates underestimated. As such, the significance of the effect reported in the meta-analysis is likely to be highly due to the dependence within the effect sizes (M. W. L. Cheung, 2015a). Another method of addressing multiple effect sizes is to calculate an average effect size for each included study with more than one effect size. However, the suitability of this approach depends on the research question at hand. In Study 1, the effect sizes regarding different physical activity domains could not be averaged, as understanding the difference between these effect sizes was the primary objective of the study.

The third option involves multivariate meta-analyses and three level meta-analyses, which can both handle non-independent effect sizes. However, a multivariate meta-analysis requires the author to estimate the sampling covariance. As the correlations between multiple outcomes in a single study and between studies of similar samples were unknown, a covariance matrix could not be specified (M. W. L. Cheung, 2015a). As such, a three level meta-analysis was used to analyse the data. A three level meta-analysis was also advantageous as it enabled the heterogeneity that occurs within the studies and their multiple effect sizes to be disentangled (M. W. L. Cheung, 2015a).

Fixed, random, or mixed-effects models. A fixed-effects model assumes that one true effect size exists and that differences between the effect sizes are only due to sampling error, whereas, random-effects models allow true effect sizes to differ between studies due to factors other than sampling error (Borenstein, Hedges, Higgins, & Rothstein, 2010). Given that differences in effect sizes could be due to different populations, different physical activity domains, and different mental health outcomes,

rather than sampling errors alone, a random-effects model was more appropriate (Borenstein et al., 2010). A mixed-effects meta-analysis also accounts for dependency among effect sizes, like a random-effects model, but includes a number of moderator variables in attempt to understand the source of heterogeneity (M. W. L. Cheung, 2015a). As such, a series of mixed-effects meta-analyses were ideal for addressing the Study 1 research questions.

Study 2

The aim of data analysis in Study 2 was to systematically reduce the data to a number of concepts which answer the research questions. To achieve this aim, thematic data analysis involved assigning codes to passages of text. Some codes were manifestations of the data, while others were latent codes based on self-determination theory (Marks & Yardley, 2004). Broader categories were then developed to draw out relationships between different codes in order to reflect the participants' perspectives and experiences (Patton, 2002). In order to ensure the results are a genuine representation of the phenomenon (Anderson, 2010), a number of procedures were carried out and are explained briefly below.

Theoretical saturation. Theoretical saturation is reached when new data collected and analysed fails to produce any new categories or concepts that extend understanding so that the researcher is unable to draw out any new themes from the data (Weed, 2009). While it was originally intended that three schools may be necessary, theoretical saturation was reached after collecting and analysing data from two schools, such that a third school was not recruited.

Establishing trustworthiness. Credibility, dependability, confirmability, and transferability are all procedures which ensure qualitative research is trustworthy (Denzin & Lincoln, 2008). Credibility refers to how authentic the interpretations made

in the results are (Patton, 2002). Two strategies were carried out in order to ensure credibility of the results. Firstly, theoretical sensitivity refers to gaining knowledge of the phenomenon through past research, and so an extensive literature search of the relationship between physical activity and affective wellbeing was conducted before completing data analysis. Additionally, an in-depth understanding of the tenets of self-determination theory was also acquired beforehand. Secondly, triangulation involves sampling different groups and different people to verify the perspectives of one group against the other. Although a relatively specific sample was recruited for Study 2, it was important to ensure two different schools were recruited, rather than two year groups at the one school. Dependability involves the extent to which a research project is suitable to answering the research questions (Lincoln & Guba, 1985). Piloting the computer-assisted-self-interview ensured that the questions and probes guided the participants to answering the questions effectively, such that useful data was gathered, and the research questions were able to be addressed. Confirmability involves presenting results which are in line with the participants' views (Merriam, 1998). In order to achieve confirmability extensive notes were made which described both the codes themselves, and the process undertaken to join codes under higher order concepts. Finally, while it cannot be determined whether the findings of Study 2 are transferable to other participants, the results section contains detailed descriptions enabling a reader to make their own interpretations regarding whether the findings are transferable (Graneheim & Lundman, 2004).

Study 3

Aiken's item content-validity. Aiken's (1985) item content-validity coefficients (V) represent the ratio of the experts' ratings against the highest possible rating according to the scale used, and were calculated via the following formula:

$$V = \frac{\Sigma(r_i - l_o)}{n(c - 1)}$$

where, $r = i$ -th rater's rating, $l_o =$ the lowest category (i.e., 1), $c =$ the number of successive integers in the response scale used by experts (i.e., 5), and $n =$ the number of expert raters (i.e., 25). Therefore, in Study 3 the formula equalled:

$$V = \frac{\Sigma(r_i - 1)}{n(5 - 1)}$$

Cohen's d effect size. Cohen's (1977) d values were calculated by the following formula:

$$d = \frac{X_1 - X_2}{S_{pooled}}$$

where, $X_1 =$ the mean rating of one item on one subscale (e.g., autonomous motivation) and $X_2 =$ the mean rating of the same item on another subscale (e.g., controlled motivation), and $S_{pooled} =$ the pooled SD of both subscales. Therefore, the d value calculated represents the magnitude of difference in the experts' mean rating for an item's match to two different subscales. If $d > .80$ then it was considered that the experts rated the match of the item differently for the two subscales. The pooled SD was calculated via the following formula:

$$S_{pooled} = \frac{(S_1^2 (n_1 - 1) + (S_2^2 (n_2 - 1))}{(n_1 + n_2 - 2)}$$

where, S_1 and S_2 represent the SD for the two subscales, and n_1 and n_2 represent the sample size for both subscales, both of which was 25. Therefore, the pooled SD was calculated by:

$$S_{pooled} = \frac{(S_1^2 \times 24) + (S_2^2 \times 24)}{48}$$

Confirmatory factor analysis. Confirmatory factor analysis (CFA) uses a SEM framework to test hypotheses regarding how well observed variables measure latent constructs (Bowen & Guo, 2011). The latent constructs (i.e., factors) represent a theoretical concept which cannot be measured directly. In the case of Study 3, an instrument was developed to measure three theoretical concepts (i.e., autonomous motivation, controlled motivation, and amotivation). Since these three concepts cannot be directly measured the validity of the instrument needed to be determined to be sure that the items within the instrument actually measured the hypothesised three factors. Consequently, the goal of CFA is to determine both the parameter estimates such as interrelationships, and the model's goodness of fit (Hu & Bentler, 1999). Both incremental fit indices such as the comparative fit index (CFI), and absolute fit indices including the standardised root mean square residual (SRMR) and root mean squared error of approximation (RMSEA), are useful for evaluating the fit of a model alongside the chi-squared (χ^2) test, which measures the inconsistency between the sample covariance and fitted covariance matrices (Hu & Bentler, 1999). A CFI close to .95, a SRMR \leq .08, and a RMSEA close to .06 indicate very good fit (Hu & Bentler, 1999) and were used as guidelines in Study 3.

Multi-trait/multi-method CFA. Similar to a standard CFA model discussed above, a multi-trait/multi-method CFA tests how well a hypothesised model fits the data. However, a multi-trait/multi-method CFA not only includes multiple factors (i.e., traits) within an instrument, but it also includes multiple instruments (i.e., methods) within the one CFA model (Cresswell & Eklund, 2006). While the parameter estimates and fit indices for each instrument could be determined by running two separate CFA models, including both measures in the one model enabled the researcher to estimate the interfactor correlations between the two measures and make conclusions about the convergent and discriminant validity (Byrne, 1994). The extent to which the matching

factors (i.e., the same factor as measured by two different instruments) are correlated is an indication of convergent validity, while negligent correlations between non-matching factors suggests discriminant validity (Cresswell & Eklund, 2006).

Study 4

Power analysis. To the author's knowledge there had been no studies on the relationship between leisure-time specific physical activity and affective wellbeing. However, Teychenne et al. (2010) reported an inverse relationship between leisure-time physical activity and depression (OR = 0.65) in a sample size of 3,645 participants. To detect an effect of this size (OR = 0.65), with 80% power, it was estimated that a sample size of 215 participants would be required. In comparison to leisure-time physical activity, Asztalos et al. (2009) reported that biking to work was associated with reduced psychological distress in 1,919 young adults (OR = 0.70). To detect an effect of this size (OR = 0.70), with 80% power, a sample size of 315 participants would be required. Therefore, to examine the direct relationships between physical activity within these two domains and affective wellbeing, it was estimated that 315 participants were required. However, to examine the moderation role of self-determined motivation, the sample size needs to be multiplied by four (P. G. Smith & Day, 1984). Therefore, to detect the moderation of self-determined motivation, in the relationships between domain-specific physical activity and affective wellbeing, based on the smaller effect (i.e., active travel, OR = 0.70), a sample size of 1,260 participants was required ($315 \times 4 = 1,260$) in order for results to be 80% powered. With a sample of 1,632 participants, Study 4 was adequately powered.

Accelerometer processing. All accelerometer data for this thesis was processed in ActiLife, an actigraphy data analysis software platform. Firstly, each accelerometer worn was downloaded in ActiLife. This process created one file for each participant.

Each file consisted of a string of count-values representing raw acceleration at each 1-second epoch during which the accelerometer was initialised to record data. Data reduction then took place to reduce each individual's data file by excluding the time the accelerometer was not worn. Using the wear-time validation tool in ActiLife, all strings of consecutive zero count-values lasting ≥ 60 minutes were removed from the data file. However, a 1-2 minute spike tolerance of ≤ 100 counts per minute was allowed. This spike tolerance was designed to mimic the code used in the 2003-2004 National Health and Nutrition Examination Survey (NHANES) for eliminating non-wear time. Through this process, a new data file was created for each individual which was identical to the original file, except that all non-wear periods were removed, leaving only a count-value for each 1-second epoch of data during which the accelerometer was likely to be worn.

Each 1-second epoch within the new wear-time files was then converted to its 60-second epoch equivalent (e.g., a 1-second epoch count value of 45 would be scaled up to an equivalent 60-second epoch count-value of 2,700) as intensity categories are based on counts per minute. Each up-scaled 1-second epoch was then assigned to an intensity category based on Evenson's (2008) equations for children between six and 18 years of age, where *sedentary* = 0-100 counts per minute, *light* = 101-2295 counts per minute, *moderate* = 2296-4011 counts per minute, *vigorous* ≥ 4012 counts per minute, and *moderate-to-vigorous* ≥ 2296 counts per minute. This process calculated time spent in moderate-to-vigorous physical activity as well as the percentage of time spent in moderate-to-vigorous physical activity across the entire wear-period. However, given that Study 4 focused on two specific physical activity domains, ActiLife's "Log Diaries" function was used. The "Log Diaries" function performs exactly as explained above but allows data to be analysed within different time periods for each participant. An excel spreadsheet containing specific start and stop times for each individual – signalling when their travel-time and leisure-time started and stopped each morning and

afternoon – was imported into ActiLife. This process enabled the calculation of moderate-to-vigorous physical activity during each domain.

Latent variable interaction SEM to test for moderation. A moderation analysis involves three or more variables in which the presence of one of the variables influences the relationship between the other two variables (see Figure A2; Little, Card, Bovaird, Preacher, & Crandall, 2007). As such, moderation exists when different levels of the moderator variable (W) contribute to variation in the strength or direction of the relationship between the independent variable (X) and dependent variable (Y) (Little et al., 2007). The latent moderated structural equations (LMS) method utilises mixture distributions based on an analysis of multivariate density of the independent and moderator variables to model the interaction between W and X and takes into account the non-normality of the interaction (XW) (Klein & Moosbrugger, 2000).

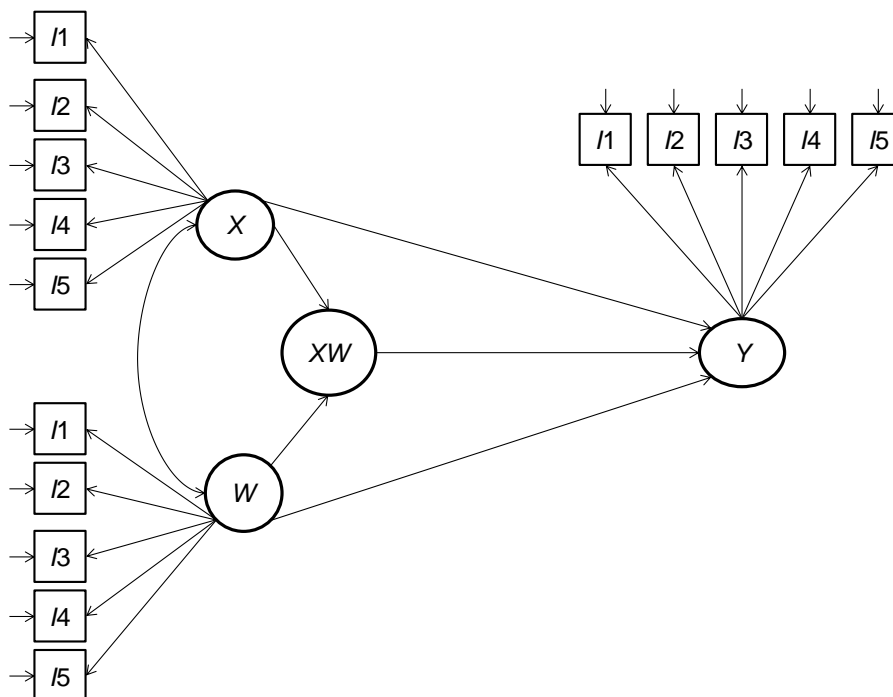


Figure A2. Structural equation model with interaction between latent variables.

If the effect of XW is significant then the relationship between X and Y is said to be moderated by W (Little et al., 2007). This is because the combination of the two

variables (XW) explains variability in the outcome variable above and beyond either the independent variable or the moderator variable alone (Little et al., 2007). This made it possible to determine if the influence that physical activity had on affect was moderated by motivation.

Appendix B: Supplementary Material (Study 1)

Table B1

Full List of Systematic Review Search Terms

Physical Activity Keywords	Mental Health Keywords	Domain-Specific Keywords		Excluded Terms		
“physical activit*”	“mental health”	domain*	domestic	Femur	Arousal	Ankle
“physical inactivity”	“mental well*being”	“types of”	housework	Patella	“heat stress”	Resistance
exercise	“psychological well*being”	“leisure time”	household	Knee	Ventricular	Rheumatology
sport*	“subjective well*being”	“leisure-time”	PE	Hip	“stress test*”	Lumbar
walking	“life satisfaction”	Sport*	P.E.	Lung	Renal	Gait
	“positive affect”	travel	“physical education”	Lactate	Heart	Rats
	“negative affect”	commut*	Occupation*	Contraction	Injur*	Metaboli*
	“mental illness”	transport*		Serum	Cardiovascular	Sclerosis
	“mental disorder*”	Transport-related		“Cartilage stress”	Diabetes	Stroke
	depress*	cycling		“Oxidative stress”	Trauma*	Dementia
	anxiety	walking		Cancer	Muscle	Biomechanics
	stress	work		Performance	Spin*	Ergonomics
	“psychological distress”	work-related		Horses	Arthritis	
				“Stress urinary incontinence”		

Full search extracted from Scopus

((TITLE-ABS-KEY (**commut***) OR TITLE-ABS-KEY ("**leisure time**") OR TITLE-ABS-KEY ("**leisure-time**") OR TITLE-ABS-KEY ("**types of**") OR TITLE-ABS-KEY (**domain***) OR TITLE-ABS-KEY (**work**) OR TITLE-ABS-KEY (**occupation***) OR TITLE-ABS-KEY (**travel**) OR TITLE-ABS-KEY (**housework**) OR TITLE-ABS-KEY (**sport***) OR TITLE-ABS-KEY (**transport***) OR TITLE-ABS-KEY (**cycling**) OR TITLE-ABS-KEY (**domestic**) OR TITLE-ABS-KEY (**work-related**) OR TITLE-ABS-KEY (**transport-related**) OR TITLE-ABS-KEY (**pe**) OR TITLE-ABS-KEY (**p.e.**) OR TITLE-ABS-KEY ("**physical education**") OR TITLE-ABS-KEY (**household**)) AND SUBJAREA (**mult** OR **medi** OR **nurs** OR **vete** OR **dent** OR **heal** OR **mult** OR **arts** OR **busi** OR **deci** OR **econ** OR **psyc** OR **soci**)) AND ((TITLE-ABS-KEY ("**mental health**") OR TITLE-ABS-KEY ("**mental well*being**") OR TITLE-ABS-KEY ("**psychological well*being**") OR TITLE-ABS-KEY ("**subjective well*being**") OR TITLE-ABS-KEY ("**life satisfaction**") OR TITLE-ABS-KEY ("**positive affect**") OR TITLE-ABS-KEY ("**negative affect**") OR TITLE-ABS-KEY ("**mental illness**") OR TITLE-ABS-KEY ("**mental disorder***") OR TITLE-ABS-KEY (**depress***) OR TITLE-ABS-KEY (**anxiety**) OR TITLE-ABS-KEY (**stress**) OR TITLE-ABS-KEY ("**psychological distress**")) AND SUBJAREA (**mult** OR **medi** OR **nurs** OR **vete** OR **dent** OR **heal** OR **mult** OR **arts** OR **busi** OR **deci** OR **econ** OR **psyc** OR **soci**)) AND ((TITLE-ABS-KEY ("**physical activit***") OR TITLE-ABS-KEY ("**physical inactivity**") OR TITLE-ABS-KEY (**exercise**) OR TITLE-ABS-KEY (**sport***) OR TITLE-ABS-KEY (**walking**)) AND SUBJAREA (**mult** OR **medi** OR **nurs** OR **vete** OR **dent** OR **heal** OR **mult** OR **arts** OR **busi** OR **deci** OR **econ** OR **psyc** OR **soci**)) AND NOT TITLE-ABS-KEY (**femur**) AND NOT TITLE-ABS-KEY (**patella**) AND NOT TITLE-ABS-KEY (**knee**) AND NOT TITLE-ABS-KEY (**hip**) AND NOT TITLE-ABS-KEY (**lung**) AND NOT TITLE-ABS-KEY (**lactate**) AND NOT TITLE-ABS-KEY (**contraction**) AND NOT TITLE-ABS-KEY (**serum**) AND NOT TITLE-ABS-KEY (**performance**) AND NOT TITLE-ABS-KEY ("**heat stress**") AND NOT TITLE-ABS-KEY (**arousal**) AND NOT TITLE-ABS-KEY ("**stress urinary incontinence**") AND NOT TITLE-ABS-KEY ("**cartilage stress**") AND NOT TITLE-ABS-KEY (**renal**) AND NOT TITLE-ABS-KEY ("**oxidative stress**") AND NOT TITLE-ABS-KEY ("**stress test***") AND NOT TITLE-ABS-KEY (**ventricular**) AND NOT TITLE-ABS-KEY (**heart**) AND NOT TITLE-ABS-KEY (**injur***) AND NOT TITLE-ABS-KEY (**diabetes**) AND NOT TITLE-ABS-KEY (**muscle**) AND NOT TITLE-ABS-KEY (**spine**) AND NOT TITLE-ABS-KEY (**arthritis**) AND NOT TITLE-ABS-KEY (**trauma***) AND NOT TITLE-ABS-KEY (**ankle**) AND NOT TITLE-ABS-KEY (**sclerosis**) AND

NOT TITLE-ABS-KEY (**stroke**) AND NOT TITLE-ABS-KEY (**metaboli***) AND
NOT TITLE-ABS-KEY (**dementia**) AND NOT TITLE-ABS-
KEY (**biomechanics**) AND NOT TITLE-ABS-KEY (**ergonomics**) AND
NOT TITLE-ABS-KEY (**resistance**) AND NOT TITLE-ABS-
KEY (**rheumatology**) AND NOT TITLE-ABS-KEY (**lumbar**) AND
NOT TITLE-ABS-KEY (**gait**) AND NOT TITLE-ABS-KEY)

Table B2

Summary of Studies Included in the Systematic Review

Author	Study Design	Country	Sample	Age (years)	Physical Activity Domain	Physical Activity Measure	Mental Health Measure
Aldana (1996)	Cross-sectional	United States	32,229 adults (57% female)	M = 37.3	Leisure time	1985 National Health Interview Survey	Strain Questionnaire
Armstrong (2004)	Experimental	Australia	19 adults (100% female)	Mo. = 30	Leisure time	n/a	Edinburgh Postnatal Depression Scale
Asztalos (2009)	Cross-sectional	Belgium	1,919 adults (47% female)	R = 20 - 65	Leisure time, Transport, Household	Flemish Physical Activity Computerized Questionnaire	GHQ12, Perceived Stress Scale
Balboa-Castillo, (2011)	Longitudinal	Spain	1,097 older aged (52% female)	M = 70.3 ± 5.6	Leisure time	Nurses' Health Study and the Health Professionals' Follow-up Study.	Spanish version of the SF-36
Barrington (2012)	Cross-sectional	United States	621 adults (57% female)	R = 18 - 65	Leisure time	Two items from the Godin Leisure-Time Exercise Questionnaire, one item from the IPAQ	Perceived Stress Scale-10
Bernaards (2006)	Longitudinal	Netherlands	1,747 adults (sex not reported)	Not reported	Leisure time	Frequency of PA	Dutch Version of the CES-D
Bertheussen (2011)	Cross-sectional	Norway	4,500 middle and older aged adults (56% female)	M = 53.1 ± 15	Leisure time	The number of times the participant exercised last week.	SF-8 Health Survey
Binsinger (2006)	Longitudinal	France	1,791 adolescents (53% female)	M = 11.1 ± 0.5	Leisure time	Do you do an extracurricular sport? Hours per week?	State-Trait Anxiety Inventory
Birkeland (2009)	Longitudinal	Norway	924 adolescents (45% female)	R = 13 - 23	Leisure time	One item	Seven item inventory
Bogaert (2014)	Cross-sectional	Belgium	1,066 adults (68% female)	M = 40.3 ± 9.7	Leisure time, Work, Transport, Household	IPAQ	SF-36
Borges (2013)	Cross-sectional	Brazil	1,656 older aged (64% female)	R = 60+	Leisure time	IPAQ	Geriatric Depression Scale
Branco (2014)	Cross-sectional	Brazil	1,953 young adults (55% female)	R = 18 - 35	Leisure time	IPAQ	Mini International Neuropsychiatric Interview 5.0 (MINI)
Brooks (2014)	Cross-sectional	England	4,404 adolescents (sex not reported)	Year 7, 9, and 11	Leisure time	Frequency and duration of vigorous exercise undertaken during leisure-time.	From the Health Behaviour in School-Aged Children World Health Organisation study
Brunes (2013)	Cross-sectional	Norway	38,743 adults (56% female)	M = 51.2 (females) M = 55.1 (males)	Leisure time	Frequency, duration, and intensity of weekly leisure-time PA	Hospital Anxiety and Depression Scale

Brunes (2014)	Longitudinal	Norway	23,991 adults (53% female)	M = 51.2 (females) M = 55.1 (males)	Leisure time	over last 12 months. Self-report job rated as sedentary, frequent walking, frequent lifting, or heavy manual labor. Frequency, duration, and intensity of weekly leisure-time PA over last 12 months.	Hospital Anxiety and Depression Scale – Anxiety Subscale
Bültmann (2002)	Longitudinal	Netherlands	7,208 adults (25% female)	R = 18 - 65	Leisure time	One item	GHQ12
Bustamante (2013)	Cross-sectional	United States	174 middle and older aged adults (74% female)	M = 65.97 ± 9.12	Leisure time, Household	40-item Community Healthy Activities Model Program for Seniors (CHAMPS) PA questionnaire	CES-D
Buttery (2014)	Cross-sectional	Germany	39,001 adults (56% female)	M = 48.1	Leisure time	One item	Health Related Quality of Life - 4, Self-reported depression diagnosis
Cerin (2009)	Longitudinal	Australia	2,194 adults (64% female)	M = 46.3 ± 12.0	Leisure time, Work, Transport, Household	IPAQ	SF-12
Chen (2012)	Cross-sectional	Taiwan	2,727 older aged (51% female)	R = 65+	Leisure time	Frequency and duration of sport.	10-item Chinese version of the CES-D
Chi (2015)	Longitudinal	Taiwan	2,630 middle and older aged adults (53% female)	R = 53+	Leisure time	Frequency, duration, and intensity of Leisure Time Physical Activity	CES-D
Choi (2008)	Cross-sectional	United States	188 adults (100% female)	M = 41 ± 10.96	Leisure time	IPAQ-Long Version	20-item Korean version of the CES-D
Craike (2010)	Cross-sectional	Australia	4,702 adults (100% female)	M = 34.6 ± 5.23	Leisure time	One item	"How difficult do you feel your life is at the moment?", Kessler Psychological Distress Scale
Desha (2007)	Cross-sectional	United States	727 adolescents (51% female)	M = 15.26	Leisure time	The Sport Involvement Index	Hovac's Children's Depression Inventory
Doerksen (2014)	Longitudinal	United States	33 adults (42% female)	R = 15+	Leisure time	Leisure Activity Scale	Satisfaction with Life Scale, Perceived Stress Scale, CES-D, Kuppens Affect Scale, State-Trait Anxiety Inventory
Dupuis (1995)	Cross-sectional	Canada	743 middle and older aged adults (58% female)	R = 55+	Leisure time	Frequency, duration, and intensity of participation in physically active	CES-D Bradburn Affect Scale

Eime (2014)	Cross-sectional	Australia	793 adults (100% female)	R = 18+	Leisure time	leisure activities. Duration of PA during previous week.	SF-36 , Life Satisfaction Score
Feuerhahn (2014)	Cross-sectional	Germany	126 adults (68% female)	M = 3778 ± 10.24	Leisure time	Exercise Diary	PANAS
Fisher (2004)	Experimental	United States	582 older aged adults (59% female)	R = 65+	Leisure time	3 items about neighborhood activity level.	SF-12
Fløtnes (2011)	Longitudinal	Norway	2,000 adolescents (52% female)	R = 13 - 19	Leisure time	Frequency, duration, and intensity of training, and type of activity.	Hopkins Symptom Check List-5 (SCL-5)
Giacobbi Jr (2007)	Cross-sectional	United States	59 young adults (37% female)	M = 21.56 ± 1.94	Leisure time	Leisure-time Exercise Questionnaire (LTEQ)	PANAS
Goldfield (2011)	Cross-sectional	United States	1,259 adolescents (59% female)	M = 14.8 ± 1.8	Leisure time	The Godin Leisure-Time Exercise Questionnaire	CDI, Multidimensional Anxiety Scale for Children (MASC-10)
Griffiths (2010)	Cross-sectional	United Kingdom	13,470 children (49% female)	M = 5.2	Leisure time	One item	Strengths and Difficulties Questionnaire (SDQ)
Hamer (2009)	Longitudinal	England	4,323 middle and older aged adults (52% female)	M = 63.4 ± 9.7	Leisure time	Frequency and intensity of physical activities during leisure time.	CES-D
Hamer (2009)	Cross-sectional	Scotland	19,842 adults (54% female)	M = 45.2 ± 15.5	Leisure time, Household	Frequency of participation in ≥20mins of leisure-time PA. Frequency and duration of household PA.	GHQ12
Herman (2015)	Cross-sectional	Canada	7,725 adolescents (49% female)	R = 12 - 17	Leisure time	Adaptation of Minnesota Leisure Time Physical Activity Questionnaire	“Would you say your mental health in general is excellent, very good, good, fair, or poor?”
Humphreys (2013)	Cross-sectional	United Kingdom	989 adults (68% female)	R = 16+	Leisure time, Work, Transport	Recent Physical Activity Questionnaire, 7 day travel to work recall	SF-8
Hyde (2011)	Cross-sectional	United States	190 young adults (66% female)	M = 19.3 ± 2.8	Leisure time	The Godin Leisure-Time Exercise Questionnaire	20 items measuring four components of affect
Im (2014)	Cross-sectional	United States	542 middle aged adults (100% female)	M = 49.04 ± 6.05	Leisure time, Work, Household	Kaiser Physical Activity Survey	Depression Index for Midlife Women
Inal (2007)	Cross-sectional	Instanbul	133 older aged adults (36% female)	M = 73.9 ± 8	Leisure time	Items addressing frequency and duration	Life Satisfaction Index
Iwasaki (2001)	Cross-sectional	Canada	17,626 (sex not reported)	R = 12+ years	Leisure time	Physically active leisure index	Mental Distress Scale and Depression Scale
Jewett (2014)	Longitudinal	Canada	853 young adults (54% female)	M = 20.4	School sport	One item	One item for mental health, one item for

Joseph (2014)	Cross-sectional	United States	590 young adults (48% female)	M = 20.4 ± 1.7	Leisure time	The Godin Leisure-Time Exercise Questionnaire IPAQ	stress, Major Depression Inventory Satisfaction with Life Scale, Bradburn Affect Balance Scale SF-36
Jurakić (2010)	Cross-sectional	Croatia	989 adolescents and adults (51% female)	Not reported	Leisure time, Work, Transport, Household		
Kilpatrick (2013)	Cross-sectional	Australia	3,367 adults (72% female)	M = 46.2	Leisure time	IPAQ	Kessler Psychological Distress Scale
Kim (2014)	Cross-sectional	United States	1,708 middle and older aged adults (61% female)	M = 67.88 ± 11.17	Leisure time	4 items related to the frequency of participation	5 items were borrowed from an existing study for life satisfaction, the degree of experiencing 7 descriptive adjectives. BDI-21
Korniloff (2012)	Cross-sectional	Finland	927 older aged adults (50% female)	R = 65 - 74	Leisure time	Frequency of physical activities in leisure-time at different ages.	
Kremer (2014)	Cross-sectional	Australia	8,256 adolescents (52% female)	M = 11.5 ± 0.8	Leisure time, School sport, Physical education	Frequency of after school and weekend sport. The number of sports teams played on at school. Number of days per week attended physical education.	Short Mood and Feelings Questionnaire
Ku (2009)	Longitudinal	Taiwan	2,831 middle and older aged adults (46% female)	R = 50 - 89 (baseline)	Leisure time	“Do you usually engage in any type of leisure-time PA?”	10-item Chinese version of CES-D
Kull (2012)	Cross-sectional	Estonia	956 adults (100% female)	R = 18 - 50	Leisure time, Work, Transport	Global Physical Activity Questionnaire	BDI-21
Kwag (2011)	Cross-sectional	United States	163 older aged adults (73% female)	M = 81.84 ± 7.05	Household	Participation in lawn or yard work, gardening, or heavy housework such as vacuuming.	Perceived Stress Scale Geriatric Depression Scale
Lee (2012)	Cross-sectional	United States	624 older aged adults (72% female)	M = 77.35	Leisure time, Household	Physical Activity Level	CES-D
Lin (2008)	Cross-sectional	United States	528 adults (46% female)	M = 45.4 ± 11.3	Leisure time, Work, Household	3 day 24 hour recall	BDI-21
Lutz (2007)	Longitudinal	United States	203 adults (31% female)	M = 43.61 ± 9.79	Leisure time	Leisure-time Exercise Questionnaire	Perceived Stress Scale
Malabo (2007)	Cross-sectional	South Africa	293 adults (48% female)	M = 25.9 ± 4.20	Leisure time	The Physical Activity Index	Satisfaction with Life Scale, GHQ12, The

								Affectometer 2
Martins (2013)	Cross-sectional	Brazil	506 adults (100% male)	M = 29 ± 9.77	Leisure time, Transport	Baecke Questionnaire, Travel mode binary variable		Brazilian version of the GHQ-12
McKercher (2009)	Cross-sectional	Australia	1,995 young adults (52% female)	M = 31.4 ± 2.6 (females) M = 31.6 ± 2.6 (males)	Leisure time, Work	IPAQ		Composite International Diagnostic Interview
McKercher (2013)	Cross-sectional	Australia	1,995 adults (52% female)	M = 31.5 ± 2.6	Leisure time	IPAQ		DSM-IV Criteria for Major Depression
McKercher (2012)	Cross-sectional	Australia	6,070 adolescents (50% female)	R = 9 - 15	Transport, Physical education	Self-report duration and frequency of walking and cycling to and from school and physical education.		Negative Affect Scale of the Affect Balance Scale
Molarius (2009)	Cross-sectional	Sweden	34,645 adults (53% female)	R = 18 - 84	Leisure time	"How much do you exercise physically in your leisure time?"		One item: severity of anxiety or depression.
Moore (1999)	Cross-sectional	United States	146 middle and older aged adults (76% female)	M = 56.6 ± 6.6	Leisure time	Minnesota Leisure Time Physical Activity Questionnaire		BDI
Motl (2004)	Longitudinal	United States	4,594 adolescents (49% female)	M = 12.7 ± 0.4	Leisure time	"Do you get some regular physical activity outside of school?"		CES-D
Mouchacca (2013)	Longitudinal	Australia	1,382 adults (100% female)	M = 35.7 ± 7.7	Leisure time	IPAQ-Long Version		Perceived Stress Scale
Mouton (2000)	Cross-sectional	United States	210 older aged adults (61% female)	M = 72.12 ± 6.32	Leisure time	Minnesota Leisure Time Physical Activity Questionnaire		Geriatric Depression Scale
Mutrie (2007)	Cross-sectional	Scotland	1,742 adults (55% female)	Three age cohorts: approximately 24, 44, and 64	Leisure time, Work, Household	Amount and intensity of PA during leisure-time, work, and housework.		Hospital Anxiety and Depression Scale
Nakamura (2014)	Cross-sectional	Brazil	1,001 adults (58% female)	M = 46 ± 17 (females) M = 43 ± 16 (males)	Leisure time	IPAQ-Long Version		SF-36
Ohta (2007)	Cross-sectional	Japan	670 adults (36% female)	R = 18 - 60 years	Leisure time, Transport	State the weekly hours of leisure-time exercise engaged in. Frequency and duration of walking and bicycling.		GHQ12
Pagán (2014)	Longitudinal	Germany	53,819 adults (sex not reported)	R = 16+	Leisure time	"How often do you take part in active sports?"		"How satisfied are you with life, all things considered?"
Pasco(2011)	Cross-sectional	Australia	547 older aged adults (44% female)	R = 65 - 80	Leisure time	Subjects reported participation in habitual LT physical activity		The Structured Clinical Interview for DSM-IV Criteria

						throughout the prior year.	for Major Depression Research Version, Non-patient edition
Pastor (2003)	Cross-sectional	Spain	1,038 adolescents (51% female)	M = 16.31 ± 0.92	Leisure time	Frequency of sport participation not at school.	Two items: Frequency of feeling nervous and depressed.
Pedusic (2015)	Cross-sectional	Croatia	1,163 young adults (62% female)	M = 21.5 ± 1.8	Leisure time, work, Transport, Household	IPAQ-Long Version	Satisfaction with Life Scale
Peeters (2014)	Cross-sectional	Australia	25,596 adults (100% female)	3 age cohorts: M = 27.6 ± 1.5, M = 52.2 ± 1.5, M = 78.2 ± 1.5	Leisure time, Household	Modified version of the Active Australia Questionnaire	SF-36
Petronyte (2009)	Cross-sectional	20 European countries	106,319 adolescents (51% female)	R = 11 - 15	Leisure time	Amount of exercise during free time.	Health Behavior in School-aged Children symptom checklist.
Pickett (2012)	Cross-sectional	United Kingdom	164 adults (64% female)	M = 30	Leisure time	Leisure Time Exercise Questionnaire	BDI-II, PANAS
Purakom (2014)	Cross-sectional	Thailand	226 older aged adults (76% female)	M = 68.41 ± 6.42	Leisure time, Work, Transport	Global Physical Activity Questionnaire	Mental Health Indicator short version 2007 (TMHI-15)
Rocha (2012)	Cross-sectional	Brazil	3,597 adults (71% female)	R = 15+	Leisure time	Frequency and intensity of PA during last month.	Self-Reporting Questionnaire (SRQ-20)
Sabiston (2013)	Longitudinal	Canada	860 adolescents (54% female)	M = 12.7 ± 0.5 (baseline), M = 20.4 ± 0.7 (last cycle)	Leisure time	The number of organized sports teams involved in during the last year.	"A validated depressive symptom scale"
Sanchez-Villegas (2008)	Longitudinal	Spain	10,381 adults (sex not reported)	Not reported	Leisure time	Leisure Time Physical Activity questionnaire collecting information about 17 activities.	Self-reported physician diagnosis of depression, anxiety, or stress, or the use of antidepressants or tranquilizers.
Sanchez-Villegas (2012)	Longitudinal	Spain	4,206 adults (sex not reported)	Not reported	Leisure time	Leisure Time Physical Activity questionnaire collecting information about 17 activities.	Spanish version of the SF-3
Sasidharan (2006)	Cross-sectional	United States	774 middle and older aged adults (sex not reported)	R = 50+	Leisure time	How many hours a day did you spend walking?	Single item from the Satisfaction with Life Scale, single item from the adapted Daily Hassles Scale
Schnohr (2005)	Cross-sectional	Denmark	12,028 adults (54% female)	R = 20 - 79	Leisure time	Frequency and intensity of PA.	Do you feel stressed? How often do you feel stressed? How

Serrano-Sanchez (2013)	Cross-sectional	Spain	246 older aged adults (100% male)	R = 65+	Leisure time	Frequency and duration of PA and sport club affiliation.	satisfied have you been with your life within the last year? 10-item CES-D
Sieverdes (2012)	Cross-sectional	United States	9,580 adults (100% male)	M = 48.9 ± 9.7	Leisure time	Type, frequency, and duration of leisure-time PA.	10-item CES-D
Stephens (1988)	Cross-sectional	Canada	23,791 adults (sex not reported)	R = 15+	Leisure time	Frequency and duration of leisure-time PA.	General Well-Being Schedule, CES-D, Bradburn's Affect Balance Scale, Health Opinion Survey
Surkan (2005)	Cross-sectional	United States	409 adults (59% female)	R = 18+	Leisure time	Non-work related physical activity in the past 30 days?	Two items from the Health Related Quality of Life Scale, a question about satisfaction with life
Tessier (2005)	Longitudinal	France	3,891 adults (58% female)	M = 51.8 ± 6.1	Leisure time	Modifiable Activity Questionnaire	SF-36
Teychenne (2008)	Cross-sectional	Australia	1,501 adults (100% female)	M = 42 R = 18 - 65	Leisure time, Work, Transport, Household	IPAQ	30-item GHQ
Teychenne (2010)	Cross-sectional	Australia	3,645 adults (100% female)	R = 18 - 45	Leisure time, Work, Transport, Household	IPAQ	CES-D
Teychenne (2014)	Cross-sectional	Australia	4,065 adults (100% female)	R = 18 - 45	Leisure time	IPAQ-Long Version	10 item CES-D
Thøgersen-Ntoumani (2005)	Cross-sectional	United Kingdom	312 adults (35% female)	M = 34.11 ± 8.07	Leisure time	Baecke Habitual Physical Activity Questionnaire	Satisfaction with Life Scale
Valois (2004)	Cross-sectional	United States	4,758 adolescents (53% female)	Grade 9 - 12 Students	Leisure time, Transport, School sport	One item for leisure-time, The number of sports teams played on at school. Frequency of physical education, Self-report minutes spent exercising during physical education.	Students' Life Satisfaction Scale
Vuillemin (2007)	Cross-sectional	France	5,654 adults (59% female)	M = 47.6 ± 6.5 (females), M = 25.1 ± 4.6 (males)	Leisure time	Modifiable Activity Questionnaire	SF-36
Wang (2011)	Longitudinal	Canada	17,276 adolescents and adults (52% female)	R = 12+	Leisure time	Modified version of the Minnesota Leisure Time Physical Activity Questionnaire	Composite International Diagnostic Interview - Short Form
Wendel-Vos	Longitudinal	Netherlands	1,871 adults	M = 43.3	Leisure	Duration of	Health Related

(2004)			(53% female)	± 9.3 (females), M = 44.1 ± 9.2 (males)	time	leisure-time PA.	Quality of Life
Winjndaele (2007)	Cross- sectional	Belgium	2,616 adults (45% female)	M = 47.8 ± 12.3 (females), M = 49.3 ± 13.0 (males)	Leisure time, Transport, Household	Flemish Physical Activity Computerized Questionnaire	Perceived Stress Scale
Yang (2012)	Longitudinal	Finland	935 adults (51% female)	M = 38.4 ± 5.06 (females) M = 37.9 ± 4.97 (males)	Leisure time	Frequency and intensity of PA.	Modified version of the BDI
Zullig (2011)	Cross- sectional	United States	245 adolescents (55% female)	Year 7 and 18	Physical education	Frequency of physical education attendance.	One item

Note. For brevity only the first author is listed. BDI = Beck Depression Inventory; CES-D = Center for Epidemiological Studies Depression Scale; GHQ = General Health Questionnaire; IPAQ = International Physical Activity Questionnaire; M = mean; Mo = Mode; PA = physical activity; PANAS = Positive and Negative Affect Scale; R = range; SF = Short Form Health Survey.

Table B3

Number of Studies examining each Mental Health Variable within each Physical Activity Domain

	Positive Mental Health				Mental ill-health					
	Mental Health	Mental Wellbeing	Life Satisfaction	Positive Affect	Mental ill-health	Stress	Life Dissatisfaction	Negative Affect	Depression	Anxiety
Leisure-time PA	Older Adults n = 3,798 (k = 3)	Adults n = 36,478 (k = 6)	Adults n = 7,695 (k = 9)	Adults n = 49,204 (k = 9)	Adults n = 151,278 (k = 13)	Adults n = 57,700 (k = 10)	Adults n = 12,028 (k = 1)	Adults n = 47,496 (k = 8)	Older Adults n = 10,033 (k = 9)	Adults n = 64,214 (k = 5)
	Adults n = 22,970 (k = 8)		Adolescents n = 62,981 (k = 3)		Adolescents n = 108,989 (k = 3)				Adults n = 141,175 (k = 26)	Adolescents n = 3,050 (k = 2)
	Adolescents n = 8,726 (k = 2)				Children n = 13,476 (k = 1)				Adolescents n = 17,953 (k = 7)	
Work-related PA	Older Adults n = 226 (k = 1)	Adults n = 3,183 (k = 2)	Adults n = 1,750 (k = 1)		Adults n = 506 (k = 1)				Adults n = 47,910 (k = 7)	Adults n = 38,743 (k = 1)
	Adults n = 2,055 (k = 2)								Adolescents n = 1,742 (k = 1)	
Transport PA	Older Adults n = 226 (k = 1)	Adults n = 21,168 (k = 3)	Adults n = 1,750 (k = 1)		Adults n = 1,919 (k = 1)	Adults n = 4,535 (k = 2)		Adolescents n = 6,070 (k = 1)	Adults n = 6,102 (k = 3)	
	Adults n = 2,055 (k = 2)		Adolescents n = 4,758 (k = 1)		Adolescents n = 670 (k = 1)					
Household PA	Adults n = 2,055 (k = 2)	Adults n = 27,793 (k = 2)	Adults n = 1,750 (k = 1)		Adults n = 21,761 (k = 2)	Older Adults n = 163 (k = 1)			Older Adults n = 961 (k = 3)	
						Adults n = 4,535 (k = 2)			Adults n = 6,216 (k = 4)	
									Adolescents n = 1,742 (k = 1)	
School Sport	Adolescents n = 853 (k = 1)		Adolescents n = 4,758 (k = 1)			Adolescents n = 853 (k = 1)			Adolescents n = 8,700 (k = 2)	
Physical Education			Adolescents n = 5,003 (k = 2)					Adolescents n = 6,070 (k = 1)	Adolescents n = 7,847 (k = 1)	

Note. Blank cells indicate that no study examined the relationship between that particular physical activity domain and mental health variable. PA = physical activity.

Table B4

Risk of Bias of Included Studies

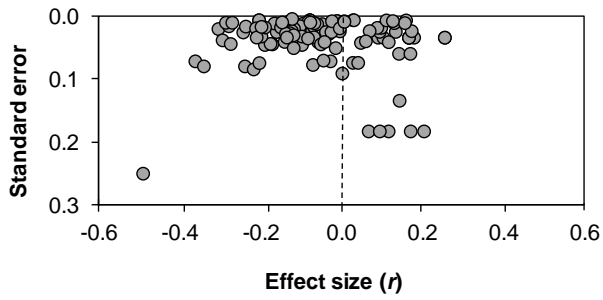
Author	Random selection of schools or participants	Eligibility criteria stated and study sample described	Valid assessment of physical activity	Valid assessment of mental health or mental ill-health	Covariates adjusted for in analyses	Power calculation reported and study adequately powered.	Risk of Bias Score /6
Aldana (1996)	0	1	0	1	1	0	3
Armstrong (2004)	1	0	1	1	0	1	4
Asztalos (2009)	1	1	1	1	1	0	5
Balboa-Castillo (2011)	1	1	1	1	1	0	5
Barrington (2012)	1	1	0	1	1	0	4
Bernaards (2006)	0	0	0	1	0	0	1
Bertheussen (2011)	1	1	1	1	1	0	5
Binsinger (2006)	0	1	0	1	0	0	2
Birkeland (2009)	0	1	1	1	1	0	4
Bogaert (2014)	1	1	1	1	1	0	5
Borges (2013)	0	0	1	1	1	0	3
Branco (2014)	1	1	1	1	1	0	5
Brooks (2014)	1	0	1	0	0	0	2
Brunes (2013)	0	1	1	1	1	0	4
Brunes (2014)	0	1	1	1	1	0	4
Bültmann (2002)	0	1	0	1	1	0	3
Bustamante (2013)	0	1	1	1	0	0	3
Buttery (2014)	1	1	0	1	0	0	3
Cerin (2009)	1	1	1	1	1	0	5
Chen (2012)	0	1	1	1	1	0	4
Chi (2015)	0	1	0	1	0	0	2
Choi (2008)	0	1	1	1	1	0	4
Craike (2010)	1	1	0	1	1	0	4
Desha (2007)	0	1	0	1	1	0	3
Doerksen (2014)	0	0	0	1	0	0	1
Dupuis (1995)	0	1	0	1	0	0	2
Eime (2014)	0	1	0	1	1	1	4
Feuerhahn (2014)	0	1	0	1	1	0	3
Fisher (2004)	1	1	1	1	0	1	5
Fløtnes (2011)	0	1	1	1	1	0	4
Giacobbi Jr (2007)	0	1	1	1	0	0	3
Goldfield (2011)	0	1	1	1	1	0	4
Griffiths (2010)	0	1	0	1	1	0	3
Hamer (2009)	0	1	1	1	1	0	4
Hamer (2009)	1	1	1	1	1	0	5
Herman (2015)	0	1	0	0	1	0	2
Humphreys (2013)	0	1	1	1	1	0	4
Hyde (2011)	0	1	1	1	0	0	3

Im (2014)	0	1	1	1	0	1	4
Inal (2007)	0	1	0	1	0	0	2
Iwasaki (2001)	0	0	0	0	1	0	1
Jewett (2014)	0	1	0	1	1	0	3
Joseph (2014)	0	1	1	1	0	0	3
Jurakić (2010)	1	0	1	1	1	0	4
Kilpatrick (2013)	0	1	1	1	1	0	4
Kim (2014)	0	1	0	0	0	0	1
Korniloff (2012)	1	1	0	1	1	0	4
Kremer (2014)	1	1	1	1	1	0	5
Ku (2009)	1	1	0	1	1	0	4
Kull (2012)	1	1	1	1	0	0	4
Kwag (2011)	0	1	1	1	0	0	3
Lee (2012)	0	1	0	1	1	0	3
Lin (2008)	0	1	1	1	1	0	4
Lutz (2007)	0	1	1	1	1	0	4
Malabo (2007)	0	1	0	1	0	0	2
Martin (2014)	0	1	0	1	1	0	3
Martins (2013)	0	1	1	1	1	0	4
McKercher (2009)	0	1	1	1	1	0	4
McKercher (2013)	1	1	1	1	1	0	5
McKercher (2012)	1	1	0	1	1	0	4
Molarius (2009)	1	1	0	0	1	0	3
Moore (1999)	0	1	1	1	1	0	4
Motl (2004)	1	1	1	1	1	0	5
Mouchacca (2013)	1	1	1	1	1	0	5
Mouton (2000)	0	1	1	1	0	0	3
Mutrie (2007)	1	1	0	1	1	0	4
Nakamura (2014)	1	1	1	1	1	0	5
Ohta (2007)	0	1	1	1	1	0	4
Pagán (2014)	0	0	0	0	0	0	0
Pasco (2011)	1	1	1	1	0	0	4
Pastor (2003)	1	1	0	0	0	0	2
Pediscic (2015)	1	1	1	1	1	1	6
Peeters (2014)	1	1	1	1	1	1	6
Petronyte (2009)	0	1	0	1	1	0	3
Pickett (2012)	0	1	0	1	1	0	3
Purakom (2014)	0	1	1	1	1	0	4
Rocha (2012)	0	1	0	1	1	1	4
Sabiston (2013)	0	1	0	1	1	0	3
Sanchez-Villegas (2008)	0	0	1	0	1	0	2
Sanchez-Villegas (2012)	0	0	1	1	1	0	3
Sasidharan (2006)	0	0	0	0	0	0	0
Schnohr (2005)	1	1	0	0	1	0	3
Serrano-Sanchez (2013)	1	1	0	1	0	0	3

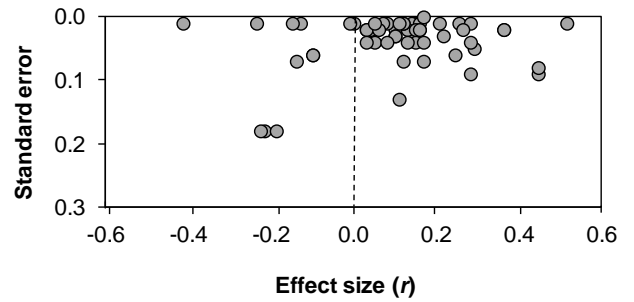
Sieverdes (2012)	0	1	1	1	1	0	4
Stephens (1988)	0	0	0	1	1	0	2
Surkan (2005)	0	1	0	0	1	0	2
Tessier (2005)	0	1	1	1	1	1	5
Teychenne (2008)	1	1	1	1	1	0	5
Teychenne (2010)	1	1	1	1	1	0	5
Teychenne (2014)	1	1	1	1	1	0	5
Thøgersen- Ntoumani (2005)	0	1	1	1	0	0	3
Valois (2004)	1	0	0	1	1	0	3
Vuillemin (2007)	1	1	0	1	1	0	4
Wang (2011)	1	1	0	1	1	0	4
Wendel-Vos (2004)	1	1	1	1	1	0	5
Winjndaele (2007)	1	1	1	1	0	0	4
Yang (2012)	1	1	1	1	1	0	5
Zullig (2011)	0	1	1	0	1	0	3

Note. For brevity only the first author is listed. 1 = present and explicitly explained; 0 = absent or inadequately discussed.

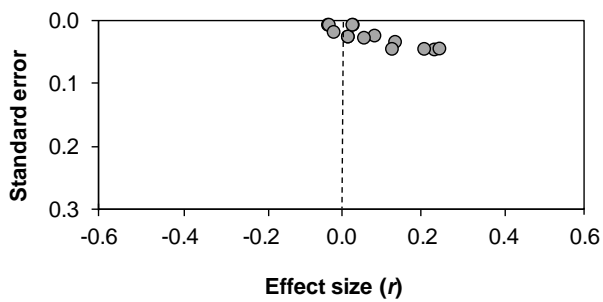
Mental ill-health



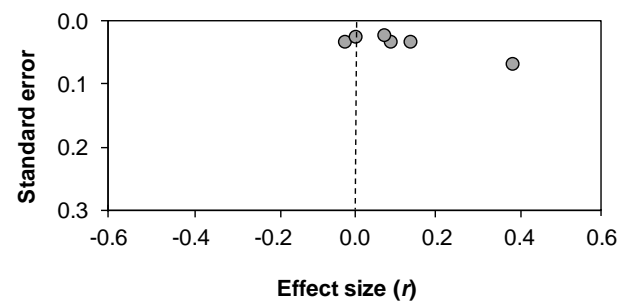
Mental Health



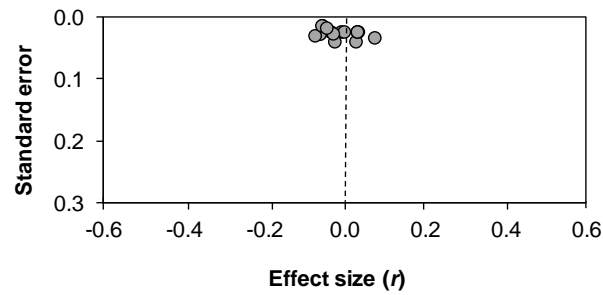
a) Leisure-time Physical Activity



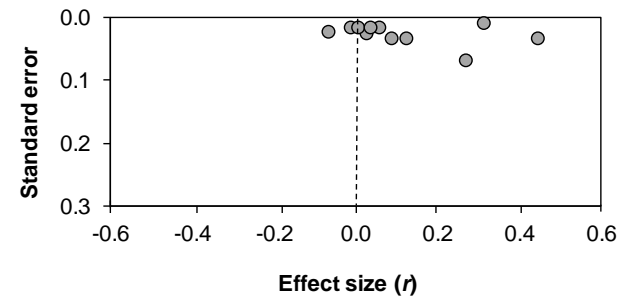
g) Leisure-time Physical Activity



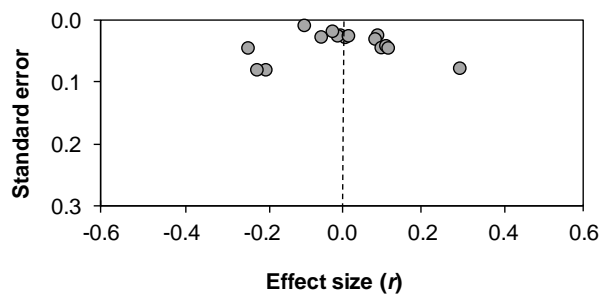
b) Work-related Physical Activity



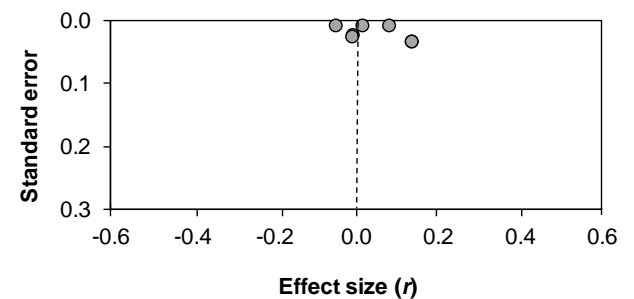
h) Work-related Physical Activity



c) Transport Physical Activity



i) Transport Physical Activity



d) Household Physical Activity

j) Household Physical Activity

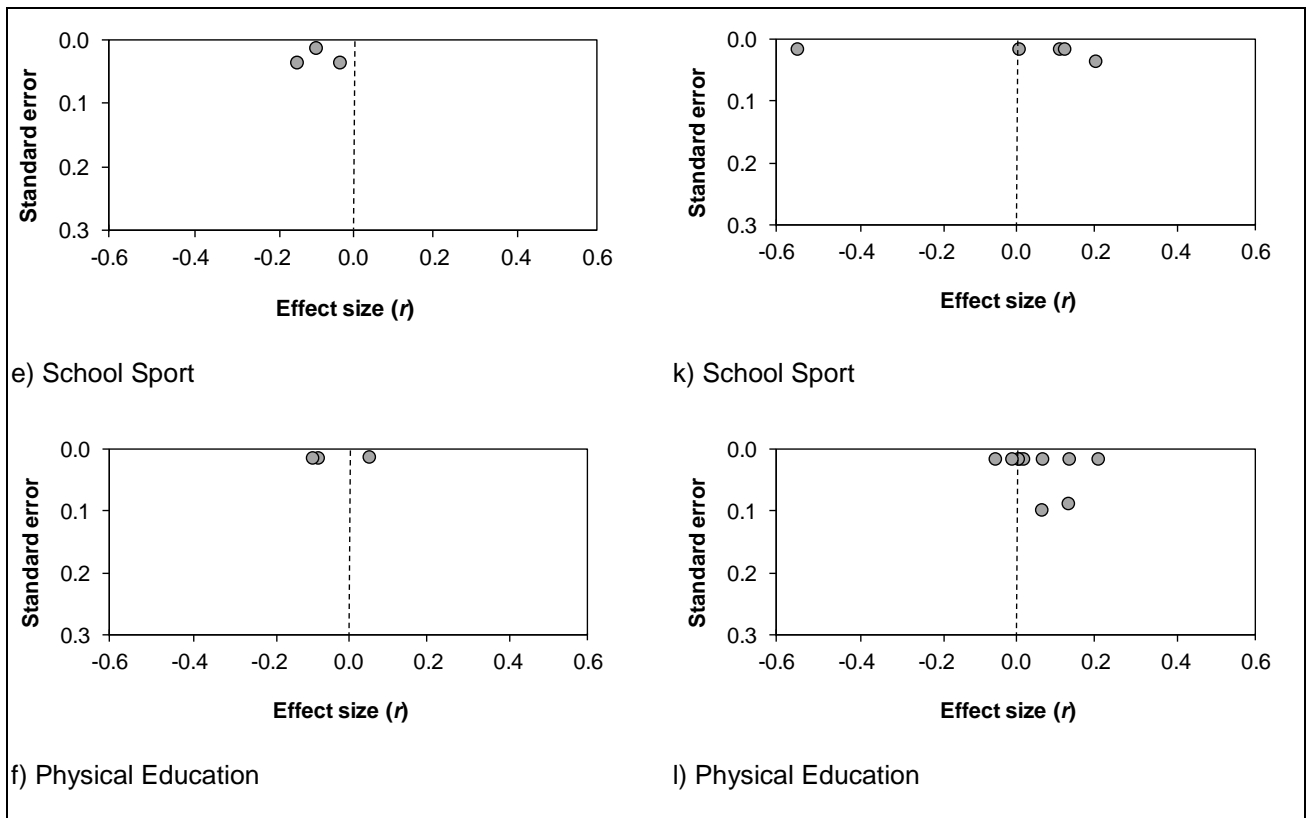


Figure B1. Individual study effect size estimates.

Appendix C: Ethics Approval Letter

The following ethics approval letter covered all aspects of this thesis.

Human Research Ethics Committee
Committee Approval Form

Principal Investigator/Supervisor: Associate Professor Chris Lonsdale
Co-Investigators: Dr Louisa Peralta, Prof Anthony Maeder, Prof Jennifer Gore, A/Prof Nikolaos Ntoumanis, A/Prof Ester Cerin (Partner Investigator), A/Prof David Lubans, Prof Gregory Kolt, Mr Ian Moyes (Project Officer)
Student Researcher: : Ms Katherine Owen, Mr Aidan Lester, Ms Rhiannon White (HDR students)

Ethics approval has been granted for the following project:
A Cluster Randomised Controlled Trial of a School-based Physical Activity Intervention in At-risk Communities
for the period: 06/06/2014 - 31/12/2016
Human Research Ethics Committee (HREC) Register Number: 2014 185N

Special Condition/s of Approval

Prior to commencement of your research, the following permissions are required to be submitted to the ACU HREC:

Permissions from governing bodies eg: Catholic Education Office and Principal permissions (where and as required). If NSW state schools - SERAP approval / permission is required.


The following standard conditions as stipulated in the *National Statement on Ethical Conduct in Research Involving Humans (2007)* apply:

- (i) that Principal Investigators / Supervisors provide, on the form supplied by the Human Research Ethics Committee, annual reports on matters such as:
- security of records
 - compliance with approved consent procedures and documentation
 - compliance with special conditions, and
- (ii) that researchers report to the HREC immediately any matter that might affect the ethical acceptability of the protocol, such as:
- proposed changes to the protocol
 - unforeseen circumstances or events
 - adverse effects on participants

The HREC will conduct an audit each year of all projects deemed to be of more than low risk. There will also be random audits of a sample of projects considered to be of negligible risk and low risk on all campuses each year.

Within one month of the conclusion of the project, researchers are required to complete a *Final Report Form* and submit it to the local Research Services Officer.

If the project continues for more than one year, researchers are required to complete an *Annual Progress Report Form* and submit it to the local Research Services Officer within one month of the anniversary date of the ethics approval.


Signed: _____ Date: 06/06/2014.....
(Research Services Officer, McAuley Campus)

Appendix D: Information Statement and Consent Form (Study 2)

The following documents were used to recruit participants and collect consent from participants involved in the qualitative investigation (Study 2).

Dr. Chris Lonsdale
School of Science and Health
University of Western Sydney
Locked Bag 1797
Penrith, NSW 2751, AUSTRALIA
Phone: (02) 9852-5403



STUDENT & PARENT/CAREGIVER INFORMATION STATEMENT

Project Title: Adolescents' physical activity experiences, their motivation, and the impact on mental health.

Dear Student,

Year 9 students in your school are invited to participate in the project identified above.

Who is carrying out the study?

The research is being conducted by Dr Chris Lonsdale (Chief Investigator) and Miss Rhiannon White (PhD candidate).

What is the study about?

This project will identify the different physical activities in which adolescents participate, and the perceived influence of these activities on mental health.

What does the study involve?

In November-December 2013, students will use iPads to complete a computerised questionnaire during one PDHPE theory lesson. This questionnaire is designed to ask students about their physical activity participation, aspects of their physical activity environments (e.g., indoors or outdoors, with other people or alone), and the emotions, feelings, and moods they experience during and after these activities.

How much time will the study take?

Students will require 30 minutes during one lesson.

Questionnaires will be:

Completed in: November-December, 2013 during class.

Stored in: an electronic file for at least 5 years, after which they will be destroyed.

Accessed by: only the research team.

Used to: publish scholarly reports, in which your child will not be identifiable.

If you have concerns about what has been recorded, you may access recordings of your child within the period of storage. These recordings can be accessed by contacting Dr. Chris Lonsdale. Children not participating in the study will participate in their usual PDHPE lesson under guidance of their PDHPE teacher.

Will the study benefit me?

This study presents no direct benefits to participating students. However, this research will provide a useful contribution to the physical activity and mental health research field by understanding where (in what settings and environments) and under what conditions (e.g., social interaction, motivation) physical activity is beneficial to mental health. Consequently, the results from this study may be useful in guiding future physical activity programs for adolescents to better promote mental health and prevent mental illness.

Will the study have any discomforts?

No amount of harm to participants is anticipated as students will not be forced to answer any question they find uncomfortable, and students' responses will not be linked to any personal details other than their gender. As such, little discomfort is expected. However, if a student does feel upset during or after reflecting on the questions, they are encouraged to speak to their class teacher or school counsellor.

How is this study being paid for?

The study is funded by the Australian Research Council.

Will anyone else know the results? How will the results be disseminated?

All aspects of the study, including results, will be confidential and only the researchers will have access to the raw data provided, in which participants' responses will be de-identified. Scholarly reports, such as journal articles, will also be published. All reports will be published in general terms and will not allow the identification of individual students or schools. Parents will also be able to view their child's response to the questionnaire if they choose.

Can I withdraw from the study?

The school principal has agreed to your school being involved in the study. However, your child's participation in the study is entirely voluntary: you are not obliged to consent. Your child may

withdraw from the study at any time - or you may withdraw your child from the study at which point all records of your child's participation will be destroyed. If you choose to withdraw from the study, you will participate in the lesson under guidance of your usual PDHPE teacher and will not complete the questionnaire. A decision not to participate or to end involvement in the study will not jeopardise your relationship with the University of Western Sydney or your school. Withdrawal from this task will not result in any disciplinary action, nor will it affect your academic grades; this is a purely voluntary research task.

Can I tell other people about the study?

Students and parents are welcome to discuss the study with others.

What if I require further information?

When you have read this information, Dr. Chris Lonsdale will discuss it with you further and answer any questions you may have. If you would like to know more at any stage, please feel free to contact Dr. Chris Lonsdale.

What if I have a complaint?

This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is H9171. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013 or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

Dr Chris Lonsdale

School of Science and Health

University of Western Sydney

Phone: (02) 9852 5403

c.lonsdale@uws.edu.au

Dr. Chris Lonsdale
School of Science and Health
University of Western Sydney
Locked Bag 1797
Penrith, NSW 2751, AUSTRALIA
Phone: (02) 9852-5403



Participant Consent Form for Parents/Caregivers

This is a project specific consent form. It restricts the use of the data collected to the named project by the named investigators.

Project Title: Adolescents' physical activity experiences, their motivation, and the impact on mental health.

I, [print name]....., give consent for my child

[print name].....to participate in the research project titled: Adolescents' physical activity experiences, their motivation, and the impact on mental health.

I acknowledge that:

I have read (or had read to me) the participant information sheet and have been given the opportunity to discuss the information and my child's involvement in the project with the researchers.

The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

I have discussed participation in the project with my child and my child agrees to his/her participation in the project.

I understand that my child's involvement is confidential and that the information gained during the study may be published but no information about my child will be used in any way that reveals my child's identity.

I understand that my child's participation in this project is voluntary. I can withdraw my child from the study at any time, without affecting their academic standing or relationship with the school and they are free to withdraw their participation at any time.

I consent to my child being involved in the:

1. Completion of a questionnaire about their physical activity experiences and their perceived influence on mental health.

Please cross out any activity for which you do not provide consent for your child to complete.

Signed:.....
(Parent/caregiver)

Signed:.....
(Child)

Name:

Name:

Date:

Date:

Please sign the consent sheet and return to your Physical Education teacher

This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is: H9171. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013 or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

PLEASE TURN OVER

Dr. Chris Lonsdale
School of Science and Health
University of Western Sydney
Locked Bag 1797
Penrith, NSW 2751, AUSTRALIA
Phone: (02) 9852-5403



STUDENT ASSENT FORM

Project Title: Adolescents' physical activity experiences, their motivation, and the impact on mental health.

I,....., agree to participate in the research project titled:
Adolescents' physical activity experiences, their motivation, and the impact on mental health.

I acknowledge that:

I have read (or had read to me) the participant information sheet and have been given the opportunity to discuss the information and my involvement in the project with the researcher/s.

The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

I agree to the:

1. Completion of a questionnaire about my physical activity experiences and the influence on mental health, and I understand that my parents will be able to view my response if they wish.

I have had an opportunity to ask a member of the research team questions about the research. I understand that my participation in this research is voluntary and I am free to withdraw from the research project at any time. My refusal to participate or withdrawal of consent will not affect my relationship with the University of Western Sydney, or my school. Withdrawal from this task will not result in any disciplinary action against me, nor will it affect my academic grades, given that this is a purely voluntary research task.

By signing below I am indicating my consent to participate in this research project conducted by Dr Chris Lonsdale, as it has been described to us in the Information Statement, a copy of which I have retained.

I understand that my involvement is confidential and that the information gained during the study may be published but no information about me will be used in any way that reveals my identity.

Student name:

Signature: **Date:**

***Please sign the consent sheet and return to your
Physical Education teacher***

This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is: H9171. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013 or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

PLEASE TURN OVER

Appendix E: Computer-Assisted-Self-Interview Questions

The aim of this questionnaire is to understand your experiences of physical activity and your beliefs regarding the benefits of different physical activities. For the purpose of this questionnaire, physical activity refers to any type of movement and may include activities such as organised sport, walking to school, chores or hobbies at home, active play in the backyard or street, and school PE.

This should take you approximately 30 minutes to complete. Your answers will only be viewed by the research team, in which your response will not be identifiable, and by your parents if they request to view your response. There is no right or wrong answer and you do not have to answer any question which you find uncomfortable or upsetting. If you do feel upset during or after reflecting on the questions you should speak to your class teacher or school counselor. You do not have to participate and there will be no consequence for withdrawing.

1. Please list three words that sum up how physical activity makes you feel?
2. Please write one or two sentences about why or how you think physical activity makes you feel this way.
3. Think of a time when you participated in physical activity and felt good (for example, happy, cheerful, lively, proud, excited, or enthusiastic) afterwards.
 - a. Describe the physical activity you participated in.
 - b. Why did you participate in this activity?
 - c. Think broadly, are there any other reasons why you participated?
 - d. In what situation did this physical activity occur (for example, school, PE, after school, at work, on the weekend, or during organised sport)?
 - e. Please describe in a sentence or two, how you felt while participating in this activity.
 - f. Please describe in a sentence or two, how you felt after completing this activity.
4. Think of a time when you participated in physical activity and felt bad (for example, sad, angry, anxious, shy, stressed, or humiliated) afterwards.
 - a. Describe the physical activity you participated in.
 - b. Why did you participate in this activity?
 - c. Think broadly, are there any other reasons why you participated?
 - d. In what situation did this physical activity occur (for example, school, PE, after school, at work, on the weekend, or during organised sport)?
 - e. Please describe in a sentence or two, how you felt while participating in this activity.

Please describe in a sentence or two, how you felt after completing this activity.

5. In which physical activities do you participate? Please select all that apply.

- | | | |
|--|---|--|
| <input type="checkbox"/> Walking | <input type="checkbox"/> Aerobic exercises at the | <input type="checkbox"/> Scooter or skateboard |
| <input type="checkbox"/> Basketball | gym (cross trainer, treadmill) | to or from school |
| <input type="checkbox"/> Dancing | <input type="checkbox"/> Gymnastics | <input type="checkbox"/> Walking to or from |
| <input type="checkbox"/> Soccer | <input type="checkbox"/> Roller skating/Ice skating | school |
| <input type="checkbox"/> Weight training | <input type="checkbox"/> Aerobics | <input type="checkbox"/> Housework |
| <input type="checkbox"/> Golf | <input type="checkbox"/> Tennis | <input type="checkbox"/> Gardening |
| <input type="checkbox"/> Boxing | <input type="checkbox"/> Rugby league | <input type="checkbox"/> Mowing the lawn |
| <input type="checkbox"/> Yoga | <input type="checkbox"/> Softball/Baseball | <input type="checkbox"/> Bicycling (including |
| <input type="checkbox"/> School PE | <input type="checkbox"/> Cricket | BMX) |
| <input type="checkbox"/> Running | <input type="checkbox"/> Bicycling to or from | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Swimming | school | _____ |

a. Please select ONE physical activity that you think brings about positive moods and emotions.

- | | | |
|--|---|---|
| <input type="checkbox"/> Walking | <input type="checkbox"/> Gymnastics | <input type="checkbox"/> Walking to or from |
| <input type="checkbox"/> Basketball | <input type="checkbox"/> Roller skating/Ice | school |
| <input type="checkbox"/> Dancing | skating | <input type="checkbox"/> Housework |
| <input type="checkbox"/> Soccer | <input type="checkbox"/> Aerobics | <input type="checkbox"/> Gardening |
| <input type="checkbox"/> Weight training | <input type="checkbox"/> Tennis | <input type="checkbox"/> Mowing the lawn |
| <input type="checkbox"/> Golf | <input type="checkbox"/> Rugby league | <input type="checkbox"/> Bicycling (including |
| <input type="checkbox"/> Boxing | <input type="checkbox"/> Softball/Baseball | BMX) |
| <input type="checkbox"/> Yoga | <input type="checkbox"/> Cricket | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> School PE | <input type="checkbox"/> Bicycling to or from | _____ |
| <input type="checkbox"/> Running | school | <input type="checkbox"/> None – no physical |
| <input type="checkbox"/> Swimming | <input type="checkbox"/> Scooter or | activity makes me feel |
| <input type="checkbox"/> Aerobic exercises | skateboard to or from | good |
| at the gym (cross | school | |
| trainer, treadmill) | | |

b. Please write a couple of sentences on why you think the physical activity you selected brings about positive moods and emotions.

c. Please select ONE physical activity that you think brings about negative moods and emotions.

- | | | |
|-------------------------------------|---|--|
| <input type="checkbox"/> Walking | <input type="checkbox"/> Aerobic exercises | <input type="checkbox"/> Scooter or skateboard to or |
| <input type="checkbox"/> Basketball | at the gym (cross | from school |
| <input type="checkbox"/> Dancing | trainer, treadmill) | <input type="checkbox"/> Walking to or from school |
| <input type="checkbox"/> Soccer | <input type="checkbox"/> Gymnastics | <input type="checkbox"/> Housework |
| <input type="checkbox"/> Weight | <input type="checkbox"/> Roller skating/Ice | <input type="checkbox"/> Gardening |
| training | skating | <input type="checkbox"/> Mowing the lawn |
| <input type="checkbox"/> Golf | <input type="checkbox"/> Aerobics | <input type="checkbox"/> Bicycling (including BMX) |
| <input type="checkbox"/> Boxing | <input type="checkbox"/> Tennis | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Yoga | <input type="checkbox"/> Rugby league | _____ |
| <input type="checkbox"/> School PE | <input type="checkbox"/> Softball/Baseball | |
| <input type="checkbox"/> Running | <input type="checkbox"/> Cricket | <input type="checkbox"/> None – no physical activity |
| <input type="checkbox"/> Swimming | <input type="checkbox"/> Bicycling to or from | makes me feel bad |
| | school | |

d. Please write a couple of sentences on why you think the physical activity you selected brings about negative moods and emotions.

6. Do you experience different moods and emotions when participating in physical activity in different settings (such as, recess and lunch, school PE, before school, after school, weekends, walking to or from school)?

For example, does physical activity in one setting make you happy while physical activity in another setting makes you scared or sad? Yes or No ?

a. Please write a small paragraph about this.

7. What physical activities do you participate in during your own free time before or after school and on weekends? Select all that apply.

- | | | |
|--|---|---|
| <input type="checkbox"/> Walking | <input type="checkbox"/> Aerobic exercises at the | <input type="checkbox"/> Scooter or skateboard to |
| <input type="checkbox"/> Basketball | gym (cross trainer, treadmill) | or from school |
| <input type="checkbox"/> Dancing | <input type="checkbox"/> Gymnastics | <input type="checkbox"/> Walking to or from |
| <input type="checkbox"/> Soccer | <input type="checkbox"/> Roller skating/Ice skating | school |
| <input type="checkbox"/> Weight training | <input type="checkbox"/> Aerobics | <input type="checkbox"/> Housework |
| <input type="checkbox"/> Golf | <input type="checkbox"/> Tennis | <input type="checkbox"/> Gardening |
| <input type="checkbox"/> Boxing | <input type="checkbox"/> Rugby league | <input type="checkbox"/> Mowing the lawn |

- | | | |
|------------------------------------|---|---|
| <input type="checkbox"/> Yoga | <input type="checkbox"/> Softball/Baseball | <input type="checkbox"/> Bicycling (including |
| <input type="checkbox"/> School PE | <input type="checkbox"/> Cricket | BMX) |
| <input type="checkbox"/> Running | <input type="checkbox"/> Bicycling to or from | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Swimming | school | _____ |

8. Why do you participate in this/these physical activities?

Examples:

- I participate in soccer during my own time because my dad used to play soccer and I grew up playing when I was little. I also find soccer training fun and I enjoy improving my skills and winning games on Saturdays. This is why I always go.
- I go for a run during my own time because doing exercise is good for you and I feel like people will think badly of me if I don't exercise, especially my friends at school. They often convince me I should go for a run or go to the gym.

9. How much choice do you have over participating in this/these activities?

- a. How do you think this influences the way you feel when participating in this activity?

10. How do you feel when you participate in physical activity during your own time?

- | | |
|------------------------------------|---------------------------------|
| <input type="checkbox"/> Joyful | <input type="checkbox"/> Afraid |
| <input type="checkbox"/> Miserable | <input type="checkbox"/> Lively |
| <input type="checkbox"/> Cheerful | <input type="checkbox"/> Scared |
| <input type="checkbox"/> Mad | <input type="checkbox"/> Proud |
| <input type="checkbox"/> Happy | <input type="checkbox"/> Sad |

- a. Please write a couple of sentences on why you think you feel this way.

11. Have you ever walked, bicycled, scootered, or skateboarded at least part of the way to or from school?

12. If yes, what is the reason for you walking, bicycling, skateboarding, or scootering to school?

Examples:

- I walk to school because my parents leave early in the morning and it's the only way I can get to school and I have to go to school. But, I also walk to school because I enjoy getting to talk to my friends along the way. It's also nice having independence and being trusted to get to school myself instead of my mum having to drive me like when I was younger.
- I don't want to, but my parents force me to and it really annoys me.

13. How much choice do you have over whether you travel to school actively or not?

a. How do you think this influences the way you feel when travelling to school?

14. How do you feel when you walk, bicycle, skateboard, or scooter to or from school? Select all that apply.

- | | |
|------------------------------------|---------------------------------|
| <input type="checkbox"/> Joyful | <input type="checkbox"/> Afraid |
| <input type="checkbox"/> Miserable | <input type="checkbox"/> Lively |
| <input type="checkbox"/> Cheerful | <input type="checkbox"/> Scared |
| <input type="checkbox"/> Mad | <input type="checkbox"/> Proud |
| <input type="checkbox"/> Happy | <input type="checkbox"/> Sad |

a. Please write a couple of sentences on why you think you feel this way.

15. Why do you participate in PE?

Examples:

- I have to participate in PE at school and the teachers make us. But, I enjoy sport so I would want to participate in PE even if I didn't have to. It's a lot of fun getting in teams and playing against our friends in things like basketball and soccer.
- I only do PE because the teachers make us. But it's a waste of time and I wish I didn't have to.

16. How much choice do you have over what you practice in PE, or how you practice it?

Does whether your teacher provides you with input in your PE class influence how you feel when doing PE, compared to when you get no choice about the tasks you do in PE?

17. How do you feel during school PE? Select all that apply.

- | | |
|------------------------------------|---------------------------------|
| <input type="checkbox"/> Joyful | <input type="checkbox"/> Afraid |
| <input type="checkbox"/> Miserable | <input type="checkbox"/> Lively |
| <input type="checkbox"/> Cheerful | <input type="checkbox"/> Scared |
| <input type="checkbox"/> Mad | <input type="checkbox"/> Proud |
| <input type="checkbox"/> Happy | <input type="checkbox"/> Sad |

a. Please write a couple of sentences on why you think you feel this way.

18. Please write anything else you would like to add.

Thank you.

Appendix F: Information Statement and Consent Form (Study 3)

The following documents were used to recruit participants and collect consent from the participants involved in the initial sample in Study 3.

Dr. Chris Lonsdale
School of Science and Health
University of Western Sydney
Locked Bag 1797
Penrith, NSW 2751, AUSTRALIA
Phone: (02) 9852-5403



STUDENT & PARENT/CAREGIVER INFORMATION STATEMENT

Project Title: Adolescents' physical activity experiences, their motivation, and the impact on mental health.

Dear Student,

Year 7 and 8 students in your school are invited to participate in the project identified above.

Who is carrying out the study?

The research is being conducted by Dr Chris Lonsdale (Chief Investigator) and Miss Rhiannon White (PhD candidate).

What is the study about?

Active travel to or from school means that you travel at least part of your journey by:

- walking
- cycling
- scooter
- skateboarding
- some other kind of physical activity

This project will identify what motivates students to actively travel to or from school.

What does the study involve?

In November-December 2013, during one lesson, students will complete a brief pen and paper questionnaire about their habits and motivation towards active travel to and from school.

How much time will the study take?

The questionnaire will take approximately 10 minutes to complete.

Questionnaires will be:

Completed in: November-December, 2013 during class.

Stored in: an electronic file for at least 5 years, after which they will be destroyed.

Accessed by: only the research team.

Used to: publish scholarly reports, in which your child will not be identifiable.

If you have concerns about what has been recorded, you may access recordings of your child within the period of storage. These recordings can be accessed by contacting Dr. Chris Lonsdale. Children not participating in the study will participate in their usual PDHPE lesson under guidance of their PDHPE teacher.

Will the study benefit me?

This study presents no direct benefits to participating students. However, adolescents who actively travel to school generally participate in greater physical activity, compared to those who are driven to school. A better understanding of what motivates adolescents to actively travel to or from school will be useful in promoting this form of physical activity, and understanding the influence of active travel on student wellbeing.

Will the study have any discomforts?

The questionnaire is brief, and responses will only be viewed by the research team. As such, little discomfort is expected.

How is this study being paid for?

The study is funded by the Australian Research Council.

Will anyone else know the results? How will the results be disseminated?

Please be assured that only the researchers will have access to the raw data provided, in which participants' responses will be de-identified. The findings of the research will be published in scholarly reports, such as journal articles. All reports will be published in general terms and will not allow the identification of individual students or schools.

Can I withdraw from the study?

The school principal has agreed to your school being involved in the study. However, your participation in the study is entirely your choice. If you agree to participate you can choose to withdraw from the study at any time and will be free to stop participation at any time. If you choose to withdraw from the study, you will participate in the lesson under guidance of your usual PDHPE teacher and will not complete the questionnaire. A decision not to participate or to end involvement in the study will not jeopardise your relationship with the University of Western Sydney or your school. Withdrawal from this task will not result in any disciplinary action, nor will it affect your academic grades; this is a purely voluntary research task.

Can I tell other people about the study?

Students and parents are welcome to discuss the study with others.

What if I require further information?

When you have read this information, Dr. Chris Lonsdale will discuss it with you further and answer any questions you may have. If you would like to know more at any stage, please feel free to contact Dr. Chris Lonsdale.

What if I have a complaint?

This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is H9171. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013 or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

Dr Chris Lonsdale

School of Science and Health
University of Western Sydney

Phone: (02) 9852 5403

c.lonsdale@uws.edu.au

Dr. Chris Lonsdale
School of Science and Health
University of Western Sydney
Locked Bag 1797
Penrith, NSW 2751, AUSTRALIA
Phone: (02) 9852-5403



Participant Consent Form for Parents/Caregivers

This is a project specific consent form. It restricts the use of the data collected to the named project by the named investigators.

Project Title: Adolescents' physical activity experiences, their motivation, and the impact on mental health.

I, [print name]....., give consent for my child

[print name].....to participate in the research project titled:

Adolescents' physical activity experiences, their motivation, and the impact on mental health.

I acknowledge that:

I have read (or had read to me) the participant information sheet and have been given the opportunity to discuss the information and my child's involvement in the project with the researchers via telephone or email.

The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

I have discussed participation in the project with my child and my child agrees to his/her participation in the project.

I understand that my child's involvement is confidential and that the information gained during the study may be published but no information about my child will be used in any way that reveals my child's identity.

I understand that my child's participation in this project is voluntary. I can withdraw my child from the study at any time, without affecting their academic standing or relationship with the school and they are free to withdraw their participation at any time.

I consent to my child being involved in the:

2. Completion of a questionnaire about their motivation towards active travel to and from school.

Please cross out any activity for which you do not provide consent for your child to complete.

Signed:.....

(Parent/caregiver)

Name:

Signed:.....

(Child)

Name:

Date:

Date:

Please sign the consent sheet and return to your Physical Education teacher

This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is: H9171. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013 or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

PLEASE TURN OVER

Dr. Chris Lonsdale
School of Science and Health
University of Western Sydney
Locked Bag 1797
Penrith, NSW 2751, AUSTRALIA
Phone: (02) 9852-5403



STUDENT ASSENT FORM

Project Title: Adolescents' physical activity experiences, their motivation, and the impact on mental health.

I,....., agree to participate in the research project titled: Adolescents' physical activity experiences, their motivation, and the impact on mental health.

I acknowledge that:

I have read (or had read to me) the participant information sheet and have been given the opportunity to discuss the information and my involvement in the project with the researcher/s.

The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

I agree to the:

1. Completion of a questionnaire about my motivation towards active travel to and from school.

Please cross out any activity which you do not agree to complete.

I have had an opportunity to ask a member of the research team questions about the research. I understand that my participation in this research is voluntary and I am free to withdraw from the research project at any time. My refusal to participate or withdrawal of consent will not affect my relationship with the University of Western Sydney or my school. Withdrawal from this task will not result in any disciplinary action against me, nor will it affect my academic grades, given that this is a purely voluntary research task.

By signing below I am indicating my consent to participate in this research project conducted by Dr Chris Lonsdale, as it has been described to us in the Information Statement, a copy of which I have retained.

I understand that my involvement is confidential and that the information gained during the study may be published but no information about me will be used in any way that reveals my identity.

Student name:

Signature: **Date:**

Please sign the consent sheet and return to your Physical Education teacher

This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is: H9171. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013 or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

PLEASE TURN OVER

Appendix G: Motivation towards Active Travel to School Scale (MATSS):

Instrument and Scoring Key

Definition of Active Travel: Active travel to or from school means that you travel at least part of your journey by: walking, cycling, scooter, skateboarding, or some other kind of physical activity. Active travel includes trips when only part of your journey was active. For example, you might walk to catch a bus.

Stem: I actively travel to or from school...

5-Point Likert Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

Items:

Autonomous Motivation	Because I enjoy it Because it is interesting Because the benefits are important to me
Controlled Motivation	Because I feel guilty if I don't Because other people (e.g., parents or friends) get upset with me if I don't Because other people (e.g., parents or friends) tell me I should
Amotivation	But I don't see why I should But I feel it is a waste of time But I don't see the point

Scoring Key:

Autonomous Motivation	Mean of the 3 autonomous items.
Controlled Motivation	Mean of the 3 controlled items.
Amotivation	Mean of the 3 amotivation items.

Appendix H: Information Statement and Consent Form (AMPED participants)

The following documents were used to recruit participants and collect consent from participants involved in the AMPED trial. These participants formed the cross validation sample in Study 3 as well as the Study 4 sample.

Dr. Chris Lonsdale
Institute for Positive Psychology and Education
Faculty of Health Sciences
Australian Catholic University
25A Barker Road, Locked Bag 2002,
Strathfield NSW 2135.
Phone: (02) 9701 4642



Research Project

Adolescent Motivation in Physical Education: The AMPED Project

STUDENT & PARENT/CAREGIVER INFORMATION STATEMENT

Dear Student,

Year 8 students in your school are invited to participate in the project identified above.

Who is carrying out the study?

The research is being conducted by Dr Chris Lonsdale (Chief Investigator) Australian Catholic University, Professor Gregory Kolt, and Professor Anthony Maeder from the University of Western Sydney (UWS), Associate Professor David Lubans and Professor Jenny Gore from the University of Newcastle, and Dr Louisa Peralta from the University of Sydney. Mr Ian Moyes will be the project manager and research students, Aidan Lester, Rhiannon White, and Katherine Owen, all from ACU, will also be part of the research team.

What is the study about?

This project will evaluate the effectiveness of a professional development training course for Personal Development, Health and Physical Education (PDHPE) teachers. The training course is designed to help PDHPE teachers motivate and engage their students in lessons. The project will also examine the impact that physical activity habits have on students' engagement (i.e., concentration, interest, and motivation) in their academic lessons, as well as their self-concept and mental well-being.

What does the study involve?

In Term 1, 2014, students will complete a 15-20 minute questionnaire during a theory lesson in their PDHPE class. This questionnaire is designed to measure students' motivation towards PDHPE and their perceptions of their teacher's behaviour during lessons. Questions designed to measure students' motivation towards physical activity outside school, as well as their self-concept and mental well-being, will be included. Personal information will also be collected at this time, including home address, mobile phone number, method of transport to and from school, gender, and birthdate. Each student's height and weight will also be measured.

During three practical PDHPE lessons, students will wear an accelerometer, which is a small, light-weight device that attaches to a belt placed around the waist and measures physical activity. These three lessons will be video recorded, so that teachers can review their teaching practice and the research team can evaluate the teachers' implementation of strategies from the training course.

Also, students will be asked to wear the accelerometer over a one week period in their own time. During this week, students will receive a text message each morning to remind them to put on their accelerometers.

Finally, the research team will video record two Mathematics lessons involving each student. At the end of each lesson, students will complete a 5-minute questionnaire measuring their perceptions of their engagement during the lesson.

This process will be repeated in Term 4 of 2014 and again in Term 2 or 3 of 2015.

At the end of the study, students' physical activity and Mathematics engagement data will be linked to their standardised scores on the Mathematics portion of the Years 7 and 9 NAPLAN (provided by the NSW Board of Studies).

How much time will the study take?

Questionnaires will be completed during class time and will require a total of 15-20 minutes of PDHPE class time at each time point, plus 5-10 minutes of Mathematics class time (60-90 minutes total). The only requirement in students' own time will be to wear the accelerometers across one week at each time point.

Will the study benefit me?

The professional development training course is designed to help teachers create a more stimulating learning environment. As a result, students may benefit from higher quality teaching, resulting in more enjoyable PDHPE lessons.

Will the study involve any discomfort for me?

Little discomfort is expected. Students will participate in PDHPE lessons in the usual way. The only difference will be to complete the questionnaires and wear the accelerometers in the PDHPE lesson, and for a one week period, which is a minor inconvenience.

How is this study being paid for?

The study is funded by the Australian Research Council.

Will anyone else know the results? How will the results be disseminated?

The researchers will keep confidential any personal information provided by students. Once the data has been collected, de-identified using a coding system and entered into an electronic data file, questionnaires and other data collection sheets will be destroyed. The electronic data files will be retained for at least 5 years, but no individual will be identifiable in published reports.

Video recordings of PE lessons will be uploaded to a secure server located at UWS. This server is only accessible via the UWS network accessed through the project website. This website will utilise access control procedures consistent with UWS policies. The research team will be able to access all videos in order to collect data, but PDHPE teachers will only have access to videos recorded during their own lessons (for the purpose of self-reflection). Video recordings of Mathematics lessons will be uploaded to a secure server located at UWS. The research team will be able to access all videos in order to collect data. Mathematics teachers will not have access to videos as a matter of course, but will be able to view videos of their own lessons upon request. No image recorded in this study will be made public under any circumstances. No image recorded in this study will be made public under any circumstances.

Video recordings will not be undertaken in a class for which a parent has previously indicated to the school that images of his or her child are not to be recorded. Video recordings will also not be undertaken in a class for which a principal, teacher, parent, or student has indicated on the consent form that he/she does not agree to video recording. A decision to refuse video or audio recording will not influence the ability of the school, teacher or student to take part in other aspects of the study.

At the end of the study, each principal and teacher will be sent a report describing the main results. Principals will not be provided with any information that could identify the results of their school (or any teacher or student) within the overall study. Teachers who make a request will be provided with summary feedback related to their teaching; no individual student's response will be provided to a teacher. Individual results will not be provided to all students, but will be available upon request by a parent or student.

Scholarly reports, such as journal articles, will also be published. All reports will be published in general terms and will not allow the identification of individual students or schools.

Can I withdraw from the study?

The school principal has agreed to your school being involved in the study. However, participation in the study is entirely your choice. If you agree to participate you can choose to withdraw from the study at any time and will be free to stop participation at any time. If you

choose to withdraw from the study, you will continue to participate in the lesson, but you will not complete any of the questionnaires, nor will you wear an accelerometer. A decision not to participate or end involvement in the study will not jeopardise your relationship with the Universities of Western Sydney, Newcastle or Sydney, or your school. Withdrawal from this task will not result in any disciplinary action, nor will it affect your academic grades; this is a purely voluntary research task.

Can I tell other people about the study?

Students and parents are welcome to discuss the study with others.

What if I require further information?

If you would like further information please do not hesitate to contact Dr Chris Lonsdale. Thank you for considering this invitation.

What if I have a complaint?

This study has been approved by the Australian Catholic University Human Research Ethics Committee. The approval number is: H9171. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Manager, Ethics c/o Office of the Deputy Vice Chancellor (Research)

Australian Catholic University, North Sydney Campus, PO Box 968, NORTH SYDNEY, NSW 2059, Ph.: 02 9739 2519, Fax: 02 9739 2870. Email: res.ethics@acu.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.



Dr Chris Lonsdale

Institute for Positive Psychology and Education

Faculty of Health Sciences

Australian Catholic University

Phone: (02) 9701 4642

chris.lonsdale@acu.edu.au

Dr. Chris Lonsdale
Institute for Positive Psychology and Education
Faculty of Health Sciences
Australian Catholic University
25A Barker Road, Locked Bag 2002,
Strathfield NSW 2135.
Phone: (02) 9701 4642



Participant Consent Form for Parents/Caregivers

I, [print name]....., give consent for my child,

[print name]....., to participate in the research project titled:

Adolescent Motivation in Physical Education: The AMPED Project

Chief Investigators: Dr Chris Lonsdale, Prof Gregory Kolt, Prof Anthony Maeder, Assoc Prof David Lubans, Prof Jenny Gore, and Dr Louisa Peralta

I acknowledge that:

I have read (or had read to me) the participant information sheet and have been given the opportunity to discuss the information and my child's involvement in the project with the researchers via telephone or email.

The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

I have discussed participation in the project with my child and my child agrees to his/her participation in the project.

I understand that my child's involvement is confidential and that the information gained during the study may be published but no information about my child will be used in any way that reveals my child's identity.

I understand that my child's participation in this project is voluntary. I can withdraw my child from the study at any time, without affecting their academic standing or relationship with the school and they are free to withdraw their participation at any time.

I consent to my child being involved in the:

1. Video recording of 15 physical education lessons.
2. Video recording of 6 Mathematics lessons.
3. Wearing of an accelerometer during PDHPE lessons and across one week.
4. Answering of questionnaires.
5. NSW Board of Studies providing my child's Years 7 and 9 NAPLAN Mathematics scores to the research team.

Please cross out any activity for which you do not provide consent for your child to complete.

Signed:.....
(Parent/caregiver)

Signed:.....
(Child)

Name:

Name:

Date:

Date:

Please sign the consent sheet and return to your Physical Education teacher

This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is: H9171.

This study has been approved by the Australian Catholic University Human Research Ethics Committee. The approval number is: H9171. Manager, Ethics c/o Office of the Deputy Vice Chancellor (Research), Australian Catholic University, North Sydney Campus

PO Box 968. NORTH SYDNEY, NSW 2059 Ph.: 02 9739 2519 Fax: 02 9739 2870 Email: res.ethics@acu.edu.au

Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

PLEASE TURN OVER

Dr. Chris Lonsdale
Institute for Positive Psychology and Education
Faculty of Health Sciences
Australian Catholic University
25A Barker Road, Locked Bag 2002,
Strathfield NSW 2135.
Phone: (02) 9701 4642



STUDENT ASSENT FORM

I,....., agree to participate in the research project titled:

Adolescent Motivation in Physical Education: The AMPED Project

*Chief Investigators: Dr Chris Lonsdale, Prof Gregory Kolt, Prof Anthony Maeder,
Assoc Prof David Lubans, Prof Jenny Gore, and Dr Louisa Peralta*

I acknowledge that:

I have read (or had read to me) the participant information sheet and have been given the opportunity to discuss the information and my involvement in the project with the researcher/s.

The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

I agree to the:

2. Video recording of 15 physical education lessons.
3. Video recording of 6 Mathematics lessons.
4. Wearing of an accelerometer during PDHPE lessons and across one week.
5. Answering of questionnaires.
6. NSW Board of Studies providing my Years 7 and 9 NAPLAN Mathematics scores to the research team.

Please cross out any activity which you do not agree to complete.

I have had an opportunity to ask a member of the research team questions about the research. I understand that my participation in this research is voluntary and I am free to withdraw from the research project at any time. My refusal to participate or withdrawal of consent will not affect my relationship with the University of Western Sydney, Newcastle or Sydney, or my school. Withdrawal from this task will not result in any disciplinary action against me, nor will it affect my academic grades, given that this is a purely voluntary research task.

By signing below I am indicating my consent to participate in this research project conducted by Dr Chris Lonsdale, as it has been described to us in the Information Statement, a copy of which I have retained.

I understand that my involvement is confidential and that the information gained during the study may be published but no information about me will be used in any way that reveals my identity.

Student name:

Signature: **Date:**

Please sign the consent sheet and return to your Physical Education teacher

This study has been approved by the University of Western Sydney Human Research Ethics Committee. The approval number is: H9171.

This study has been approved by the Australian Catholic University Human Research Ethics Committee. The approval number is: H9171. Manager, Ethics c/o Office of the Deputy Vice Chancellor (Research), Australian Catholic University, North Sydney Campus
PO Box 968. NORTH SYDNEY, NSW 2059 Ph.: 02 9739 2519 Fax: 02 9739 2870 Email: res.ethics@acu.edu.au
Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

PLEASE TURN OVER

Appendix I: Behavioural Regulation in Exercise Questionnaire-2 (BREQ-2):

Instrument and Scoring Key

Instruction: Please fill in the circle (●) that best describes the reasons why you do exercise during your free time, outside of school hours and not when travelling to or from school.

5-Point Likert Scale: 1 = not true for me, 3 = sometimes true for me, 5 = very true for me

Items:

Intrinsic Motivation	I exercise because it's fun I enjoy my exercise sessions. I find exercise a pleasurable activity. I get pleasure and satisfaction from participating in exercise.
Identified Regulation	I value the benefits of exercise It's important to me to exercise regularly. I think it is important to make the effort to exercise regularly. I get restless if I don't exercise regularly.
Introjected Regulation	I feel guilty when I don't exercise I feel ashamed when I miss an exercise session. I feel like a failure when I haven't exercised in a while.
External Regulation	Because other people say I should I take part in exercise because my friends/family say I should. I exercise because others will not be pleased with me if I don't. I feel under pressure from my friends/family to exercise.
Amotivation	I don't see why I should have to exercise I can't see why I should bother exercising. I think exercising is a waste of time. I don't see the point in exercising.



Scoring Key:

Intrinsic Motivation	Mean of the 4 intrinsic motivation items.
Identified Regulation	Mean of the 4 identified regulation items.
Introjected Regulation	Mean of the 3 introjected regulation items.
External Regulation	Mean of the 4 external regulation items.
Amotivation	Mean of the 4 amotivation items.

Appendix J: Travel Diary
















MONDAY

1. Please answer as accurately as you can about your trip TO SCHOOL on Monday morning.


What time did you leave home? Hour  Minute 

What time did you arrive at school? Hour  Minute 

Please fill in the following table based on how you got TO school and how long it took.

	You may colour MORE THAN ONE (●)	How many minutes did you spend in each type of transport?
Walk	○	hours and minutes
Bicycle	○	hours and minutes
Skateboard/Scooter	○	hours and minutes
Bus	○	hours and minutes
Train	○	hours and minutes
Car	○	hours and minutes
Other		hours and minutes

2. Please answer as accurately as you can about your trip FROM SCHOOL on Monday afternoon.

What time did you leave school? Hour  Minute 

What time did you arrive at your next destination? Hour 
















Minute 

Was this destination home or other

If other, please explain

..... 

Please fill in the following table based on your trip **FROM** school and how long it took.

	You may colour MORE THAN ONE (●)	How many minutes did you spend in each type of transport?
Walk	<input type="radio"/>	hours and minutes
Bicycle	<input type="radio"/>	hours and minutes
Skateboard/Scooter	<input type="radio"/>	hours and minutes
Bus	<input type="radio"/>	hours and minutes
Train	<input type="radio"/>	hours and minutes
Car	<input type="radio"/>	hours and minutes
Other		hours and minutes

Appendix K: Adaptation of the WHO Health Behaviour in School Children (HBSC) Questionnaire

Instruction: Physical activity is any activity that increases your heart rate and makes you get out of breath some of the time. For example, physical activity can be done in sports and playing with friends. Some examples of physical activity are running, brisk walking, rollerblading, biking, dancing, skateboarding, swimming, soccer, basketball, football, and surfing. For these next two questions, add up all the time you spend in physical activity each day during your free time. DO NOT include physical activity done during school hours (e.g. PE lessons or activities during break times) OR when travelling to or from school.

Item 1: Frequency

Outside school hours and not including travel to and from school: How often are you usually physically active in your free time, so much that you are out of breath some of the time?

Response Options: 1 = “once a month or less”, 2 = “once a week”, 3 = “2-3 times a week”, 4 = “4-6 times a week”, 5 = “Every day”

Item 2: Duration

Outside school hours and not including travel to and from school: How many hours are you usually physically active in your free time, so much that you are out of breath some of the time?

Response Options: 1 = “none”, 2 = “about half an hour per week”, 3 = “about one hour per week”, 4 = “about 2-3 hours per week”, 5 = “about 4-6 hours per week”, 6 = “about 6-7 hours per week”, 7 = “about 7-8 hours per week”, 8 = “more than 8 hours per week”

Appendix L: Positive and Negative Affect Scale (PANAS): Instrument and Scoring

Key

Instruction: This scale consists of a number of words that describe different feelings and emotions. Indicate to what extent you have felt this way during the past few weeks.

Colour ONE circle in each line (●)

5-Point Likert Scale: 1 = very slightly, 2 = a little, 3 = moderately, 4 = quite a bit, 5 = extremely

Items:

Positive Affect	Joyful
	Cheerful
	Happy
	Lively
	Proud
Negative Affect	Miserable
	Mad
	Afraid
	Scared
	Sad

Scoring Key:

Positive Affect	Mean of the 5 positive affect items.
Negative Affect	Mean of the 5 negative affect items.

Appendix M: International Society of Behavioral Nutrition and Physical Activity

Conference Abstract

Objective: Active travel to and from school increases total levels of physical activity; however, many adolescents travel passively. As motivation could influence whether adolescents actively travel to school, the aim of this study was to develop, and assess the psychometric properties of a brief measure of adolescents' motivation towards active travel to and from school, using a self-determination theory (SDT) framework; the Motivation towards Active Travel to School Scale (MATSS).

Methods: In phase 1, 25 SDT experts rated the content validity of 28 initial items. Aiken's item content-validity coefficient (V) and Cohen's effect sizes (d) were then calculated. In phase 2, an initial sample of 239 adolescents ($M = 13.25$ years, $SD = .67$) completed the MATSS and confirmatory factor analysis (CFA) was used to explore the factorial validity of the MATSS scores. A cross validation sample of 1,286 adolescents ($M = 12.95$ years, $SD = .54$) then completed the MATSS and CFA was again conducted.

Results: Validity coefficients of 24 of the initial 28 items exceeded the threshold ($V = .63$). Those $< .63$ were removed. All 24 retained items showed acceptable effect sizes ($d \geq .80$). After considering expert reviewers' comments, another eight items were removed from further analysis. A preliminary three-factor (16-items) model suggested poor fit to the data in the initial sample ($CFI = .83$, $SRMR = .10$, $RMSEA = .10$). A further seven items were removed based on low factor loadings or high cross loadings. The revised 9-item model provided good fit to the data in both the initial ($CFI = .95$, $SRMR = .07$, $RMSEA = .06$) and cross validation samples ($CFI = .95$, $SRMR = .06$, $RMSEA = .06$). Additionally, multiple-group CFAs showed no gender invariance ($\Delta CFI < .01$).

Conclusions: This is the first study to provide validity evidence of scores derived from a measure of adolescents' motivation towards active travel to school. The MATSS can be used to investigate what factors influence active travel motivation (e.g., social interaction or green space), whether motivation influences active travel behaviours, and whether motivation enhances the effects of active travel on psychological and educational outcomes.